Traffic Volume Measurement Technology using AI

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1. Introduction

In recent Japan, big data can be collected efficiently thanks to the progress of ICT, and advanced image analysis has also become possible due to the progress of AI (artificial intelligence) technology. In response to the progress of such technologies, the Ministry of Land, Infrastructure, Transport and Tourism ("MLIT") installed "Workshop on new road traffic survey system using ICT"[1] in October 2018 aiming at shift from "Survey system focused on vehicles based on the road traffic census to be conducted once in five years" to "Survey system based on constant observation, whether at ordinary times or the time of disaster, using ICT in full scale.

In realization of this new road traffic survey system, the traffic volume measurement using monitoring camera (CCTV) images for road management and AI is considered an effective means since it enables the use of existing equipment and is expected to be applied to measurement of pedestrians etc. other than cars. Then, the Road Division conducted a trend survey to six companies developing traffic volume measurement technology using AI in order to grasp the current level of domestic technology for traffic volume measurement using images and AI.

2. Trend of traffic volume measurement technology using AI

The traffic volume measurement technology using AI discussed in this paper is a technology using the vehicle detection function based on deep learning. With this technology, AI, which has learned the characteristics of moving objects (cars, pedestrians, etc.) caught in various directions, recognizes moving objects with images in road space and measures their traffic volumes.

This trend survey was conducted on measurable moving objects and accuracy in each company as of the end of 2018. Table 1 shows the outline of survey results. As regards distinction of moving objects, it is possible to distinguish two vehicle types, small or large, and two-wheeled vehicles, while a system to distinguish pedestrians, bicycles, and motorbikes was developed only by a few companies ((1)(2)(3)). For accuracy of traffic volume measurement, high accuracy is obtained in the daytime but it is difficult to detect moving objects in the night time when there is no road lighting, etc. and only the area illuminated by car light is visible, and many of the companies above are unable to measure traffic (also impossible to distinguish car types)[4].

Table 1: Trend of the traffic volume measurement technology using AI (6 companies)

Item		Maximum performance	Minimum performance	Number of companies with a certain level of performance or more
(1) Vehicle type distinction	Daytime	7 type distinction Passenger car, van, SUV, light truck, midsize bus, large-size bus, large-size truck	2 types (small size / large size)	2 types Small size / large size measurement 6/6 companies
	Night time (with streetlight)			
	Night (without streetlight)	Indistinguishable		Small size / large size measurement 0/6 companies
(2) Pedestrian measurement		Possible to observe pedestrians. (Possible to measure vehicles simultaneously)	Unmeasurable	Impossible to measure pedestrians 5/6 companies
(3) Bicycle / motorbike measurement		Bicycle and motorbike are distinguishable.	Collective measurement as two-wheeled vehicle	Measurable / distinguishable 3/6 companies
(4) Measurement accuracy	Daytime	99%	90%	Accuracy of 95% or more 4/6 companies
	Night time (with streetlight)	99%	90%	Accuracy of 95% or more 3/6 companies
	Night (without streetlight)	80%	Unmeasurable	Accuracy of 80% or more 1/6 companies
(5) AI for each image Additional learning		Not required (Not mandatory)	Required	Not required: 2/6 companies
(8) Effect of rain / snow (weather) on measurement		Almost no effect	Not verified. (Accuracy is expected to fall)	Almost no effect 2/6 companies Not verified [4/6 companies]
(7) Other Matters affecting accuracy		- Overexposure due to direct projection of light to the camera lens. - Shielding of measurement objects due to overlap of vehicles		

For images to be analyzed, various photographic areas are expected (according to height of cameras, depression angles, and other conditions). To secure high accuracy of traffic volume measurement in such environment, highly accurate vehicle detection ability using AI is required. To this end, many of the companies above need additional learning by AI about visual perception of moving objects according to the photographic areas of images to be analyzed ((5)). Effect of weather, including as rain and snow, has been verified by two companies, and it was confirmed that there is almost no effect on accuracy unless rain or snow falls on the lens ((6)). Additionally, it was confirmed that AI measurement is also difficult in a situation where recognition by observation is difficult, such as "overexposure" of images due to direct projection of vehicle light or sunlight to the lens (i.e., image turns all white) or continuous situation where the object of measurement cannot be recognized at all due to overlap of vehicles ((7)).

3. Conclusion

The present level of domestic technology with AI was found to have widely reached a practical stage for daytime measurement but have some problems for night time measurement. We are going to study to solve issues in night-time measurement, etc. for application of road traffic survey to practice.

[Detailed information][1] Workshop on new road traffic survey system using ICT
http://www.mlit.go.jp/road/ir/ir-council/ict/index.html