Introduction of Image Recognition Type Traffic Count using AI

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1. Introduction

The Ministry of Land, Infrastructure, Transport and Tourism ("MLIT") is studying a constant observation system with full utilization of ICT, aiming to shift from the conventional Road Traffic Census to be conducted every five years to a new road traffic survey system to be conducted regardless of whether at ordinary times or at the time of disaster.

As one of the efforts for establishment of such a constant observation system, NILIM conducted a study for practical use of traffic count by image recognition using Artificial intelligence (AI) ("AI traffic count") (Fig. 1) based on the images of monitoring cameras (CCTV) for road management, which enable use of existing equipment and are expected to be applied to observation of pedestrians etc. other than vehicles, and created the equipment specifications of the observation system (draft).

Introduction of AI traffic count is expected to increase the constant observation sections of national highways under direct control, which account for about 20% of all highways and where only traffic counters ("TC") are used for observation, to about 50% at maximum.

This paper reports results of the hearing about AI traffic counting technology, results of observation accuracy verification using sample images, and equipment specifications (draft).

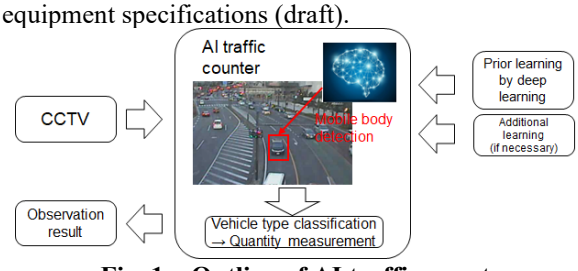

Fig. 1 Outline of AI traffic count

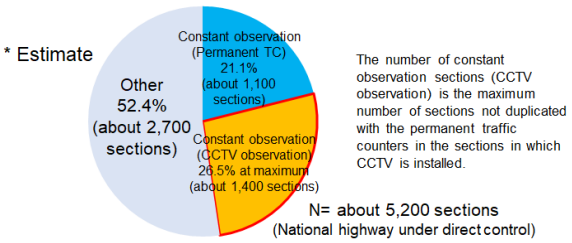

Fig. 2 Improvement of the constant observation cover ratio (national highways under direct control)

2. Results of the hearing about AI traffic counting technology

In order to create equipment specifications (draft) of AI traffic counter, we conducted a hearing survey from nine domestic private companies engaged in technical development of AI image recognition about technical requirements, including the number of lanes that can be observed, and performance requirements, including observation accuracy. Table 1 outlines the survey results.

It was found from the hearing that types of vehicles (large / small) and pedestrians can be generally observed with the present technology but that there are still issues in observation of two-wheel vehicles (bicycle, motorcycle). As response to the question of observation accuracy, they answered that it is possible to secure the accuracy in the daytime but difficult in the dark time zones including evening and night.

Other answers referred to the necessity of additional learning for each camera in order to secure the accuracy and to the effect of flare (image whitened by headlight) and occlusion (target vehicle cannot be identified due to overlap of vehicles).

Table 1 Results of the hearing about AI traffic counting technology (9 companies)

Item		Results of response
Number of lanes that can be observed		4 lanes or more: 7/9 companies
Vehicle type classification		2 types (small / large): 8/9 companies
Observation of pedestrians		Possible: 7/9 companies
Observation of two-wheel vehicles		Possible to observe / identify: 5/9 companies
Observation accuracy (Answer in the hearing / After additional learning	Daytime	Possible to secure the accuracy of 90% or more: 8/9 companies
	Night (with road illumination)	Possible to secure the accuracy of 90% or more: 6/9 companies
	Night (No road illumination)	Possible to secure the accuracy of 80% or more: 1/9 companies
AI additional learning for each image		Not required: 3/9 companies (including no provision of additional learning function)
Matters affecting accuracy		Flare due to direct projection of light to the camera lens - Shielding of measurement objects due to occlusion

3. Results of observation accuracy verification with sample images

We conducted AI observation to verify the accuracy of observation using sample images of CCTV and the technologies of 6 companies out of the hearing

respondents (Photo 1). The sample videos were taken for a total of 8 hours at two points, 4-hour time zone for each. Video images include those taken in a situation where securing the accuracy is difficult, including flare by headlight.

Fig. 3 shows the results of observation accuracy verification for all types of vehicles (conducted by 6 companies) and for only large vehicles (conducted by 4 companies). Note that additional learning was conducted for companies C and F out of the 6 companies using other images at sample points. As compared with the detection rate of all the types of vehicles, observation accuracy error in each time zone of morning and afternoon was within ±10% in 5 out of 6 companies at point 1 and in 4 out of 6 companies at point 2, which shows that sufficient accuracy was obtained from a high percentage of the companies.

On the other hand, securing the accuracy was difficult in each time zone of evening and night, resulting in a low ratio --- 3 out of 6 companies at point 1 and 2 out of 6 companies at point 2. Additionally, improvement in observation accuracy was found after learning in two companies for which additional learning was conducted.

Photo 1 Example of AI traffic counting technology

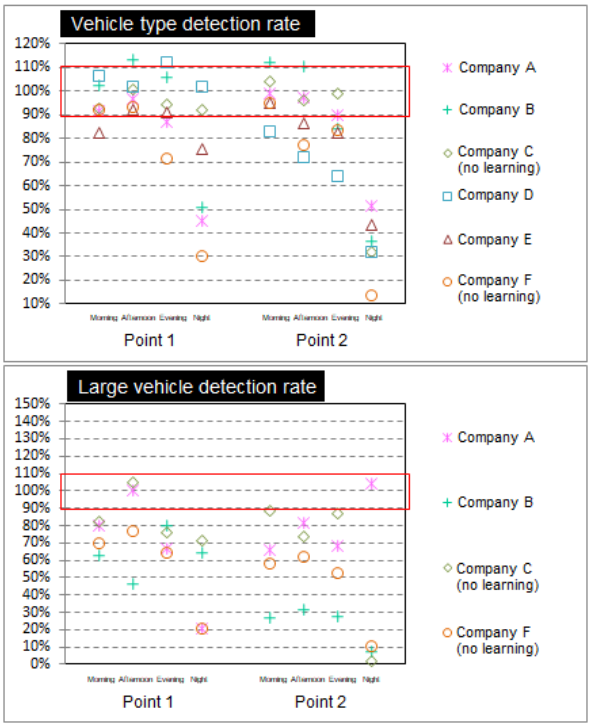

Fig. 3 Observation accuracy with sample image

For the observation accuracy of only large vehicles, observation accuracy was mostly not secured in all the companies, but improvement in accuracy was found by additional learning.

4. Equipment specifications of AI traffic counter

Table 2 shows the equipment specifications of observation device (draft) for AI traffic count, created based on the hearing results and the verification results of observation accuracy with sample images.

Table 2 Outline of the equipment specifications (draft) of AI traffic counter

Item	Specifications
Number of target lanes	4 lanes or less
Observation accuracy	Car traffic according to inbound and outbound lanes is within ±10% in the daytime (7:00-16:00
Vehicle type classification	Small car, large car (bus, truck), pedestrian, bicycle, motorcycle (No accuracy is required)

The number of lanes for observation was limited to four lanes or less. For observation accuracy, we chose to secure the observation accuracy only the daytime from 7:00 to 16:00 because it was found difficult to secure the accuracy in evening and night time zones from the results of hearing and verification. For vehicle types, we chose to obtain the observation accuracy of ±10% only for the traffic of all the vehicle types because difficulty of identifying large vehicles was expected from the verification results. However, instead of seeking accuracy, we determined as specifications that classification of small vehicles, large vehicles (bus, truck), bicycles, and motorcycles is possible, expecting for utilization in the future.

5. Conclusion

In this study, we organized the status of AI traffic count and issues in introduction, and created equipment specifications (draft). Based on these specifications, each Regional Development Bureau is advancing the introduction of AI traffic counter.

As future challenges, we need to improve the accuracy for time zones of evening and night as well as classification of vehicle types, for which securing the accuracy is difficult, and consider an approach with correction.

☞See the following for details.

1) Equipment specifications (draft) of the image recognition type traffic counter (June 2019)
http://www.mlit.go.jp/tec/it/denki/kikisiyou/touitusiyou_18gazoutorakanR0106.pdf