“AISION® Vehicle Sensing System” using AI Edge Computer to Monitor Passing Vehicles

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In recent years, there have been increasing needs to remotely grasp the situation of sites in real time, or prevent disasters and accidents to ensure a safe and secure society. On the other hand, the labor shortage to cope with these needs has become serious, and labor saving through automated systems utilizing AI is progressing in safety management work. Recently, the improved precision of surveillance cameras and advanced image analysis possible due to the spread of deep learning technology are accelerating the deployment of monitoring systems using AI. Image analysis using deep learning requires data processing that utilizes a high-performance server, and sending images to a center server for analysis is a common procedure. In this case, the network load for transmitting high-definition image data and the response time (delay) until the analysis result is received via the network have been problems.

This article introduces OKI’s image AI solution “AISION® *1),” which solves these problems, and “AISION Vehicle Sensing System,” which is an actual commercialized solution that monitors passing vehicles.

AISION

As shown in **Figure 1**, AISION is a brand name referring to the entire line of OKI’s “image AI solutions,” which solve various social problems and customer issues by using AI technology (machine learning and deep learning) to perform image analysis. It features AI technology that is implemented in edge computers and robots to analyze image data in real time and provides advanced image monitoring in the edge region. Utilizing AISION, OKI provides various image AI solutions centered on the six focus areas of “transportation,” “construction/infrastructure,” “disaster prevention,” “finance/retail,” “manufacturing,” and “marine,” and contributes to on-site safety monitoring, work efficiency, labor saving and marketing reinforcement.

AISION Vehicle Sensing System

(1) Overview

There are increasing demands for a simple image

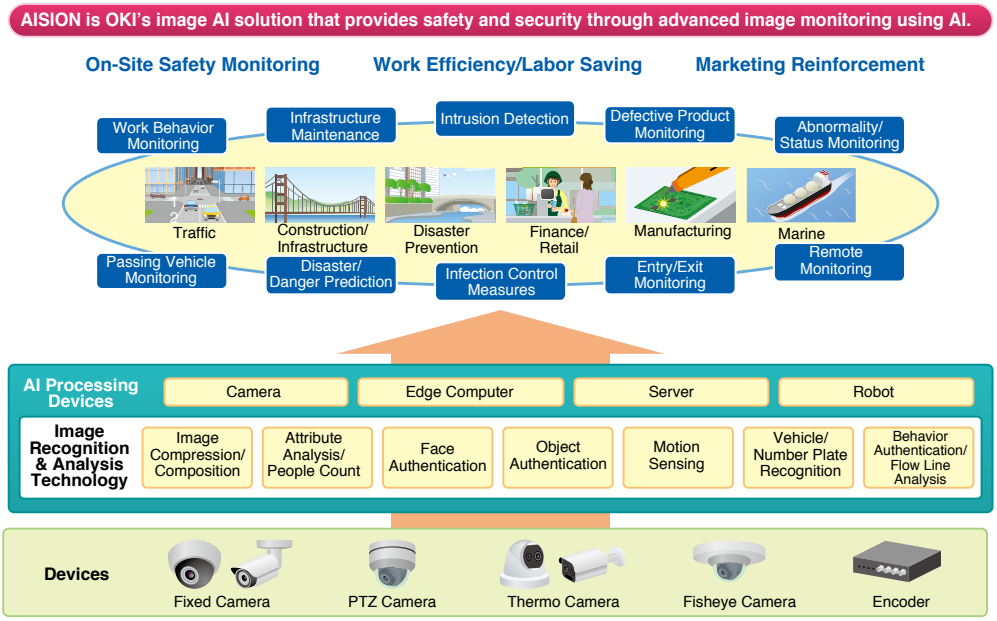

Figure 1. Image AI Solution AISION

*1) AISION is a registered trademark of Oki Electric Industry Co., Ltd.

analysis system that automates alerts to vehicles violating safe driving on factory premises, reduces safety management work, and prevents accidents caused by speeding or reverse driving on public roads. Analysis of surveillance camera images using deep learning is becoming the norm. However, this method generally requires processing on a high-performance server, and it is necessary to constantly transmit the high-quality image data from the site to a processing center via a network. For this reason, network bandwidth and operating cost have been issues for users. The AISION Vehicle Sensing System equips the AI edge computer (AE2100) shown in **Photo 1** with a vehicle sensing module and enables deep learning image analysis at the edge region. Compared to conventional image analysis, the utilization of deep learning for vehicle sensing processing improves recognition accuracy under adverse conditions such as night, rain and snow, thus makes high-precision real-time vehicle sensing at the edge possible.

Photo 1. AI Edge Computer (AE2100)

(2) Five functions

The five functions provided by the AISION Vehicle Sensing System are explained below.

1) Traffic count

The number of vehicles passing through a designated location is counted from the images of vehicles traveling on the road. The result is displayed in real-time on the web browser of a PC. The result can also be output to a CSV file.

2) Speed detection

The speed of individual vehicles and average speed of vehicles passing through a designated location are measured. Detection result can be notified via SNMP (Simple Network Management Protocol) trap, speaker, or OSD (On-screen Display) display of the camera image.

3) Reverse driving detection

Reverse driving is detected by detecting the traveling direction of vehicles passing through a designated location. Similar to speed detection, the result can be notified via SNMP trap, speaker, or OSD display.

4) IoT interworking

Figure 2 shows an example of AISION Vehicle Sensing System interworking with external IoT devices (warning beacon, speaker, electronic sign boards, etc.)

Through interworking, it is possible to promptly warn detection results. The contact output supports the AE2100 main unit, camera, and 920MHz wireless slave unit. The 920MHz wireless network (SmartHop® *3)) enables stable multi-hop wireless communication eliminating the need to wire IoT devices. This will reduce wiring cost and construction period at installation sites.

5) Image compression/recording

Images of vehicles traveling on the road are recorded onto a SD card in the AE2100. Since the recorded image of a specific time can be played and downloaded based on the log time of the detection result, it is possible to visually confirm and pinpoint a vehicle that has violated the speed limit or travelled in the reverse direction.

(3) Setup operation

For system setup and construction, a setup function that can be easily handled even without AI knowledge is

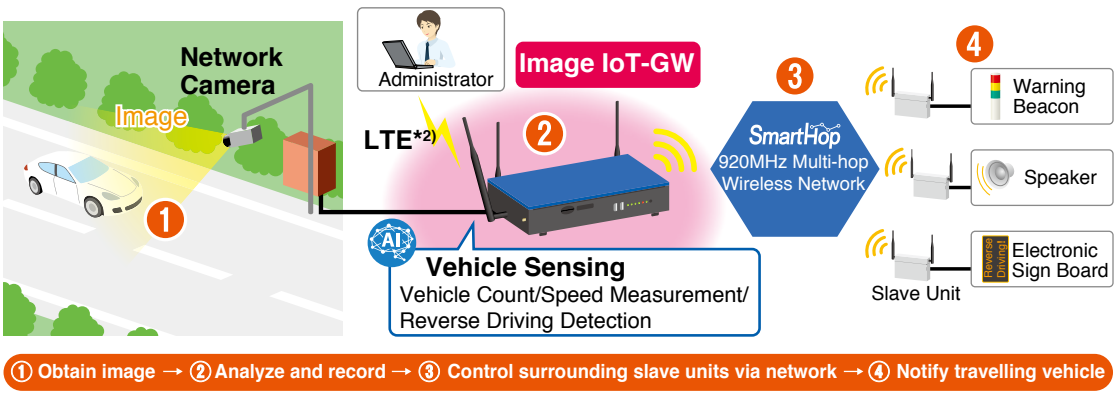

Figure 2. Warning through AISION Vehicle Sensing System and External IoT Device Interworking

*2) LTE is a registered trademark of the European Telecommunications Standards Institute (ETSI). *3) SmartHop is a registered trademark of Oki Electric Industry Co., Ltd.

provided. This setup function is packaged as a vehicle sensing application, and although it is an advanced AI system using deep learning, calibration and area/measurement line setup can be easily performed without special knowledge. An example setup operation is shown below.

1) Calibration setup

When the length of road displayed on the screen and the installation height of the camera are input, the actual scale of the road used for vehicle speed calculation is computed. The calibration setup screen is shown in **Photo 2**.

Photo 2. Calibration Setup Screen

2) Area/Measurement line setup

Area for vehicle detection and measurement lines for counting are setup on the road screen. As shown in **Photo 3**, up to eight measurement lines can be setup within the area.

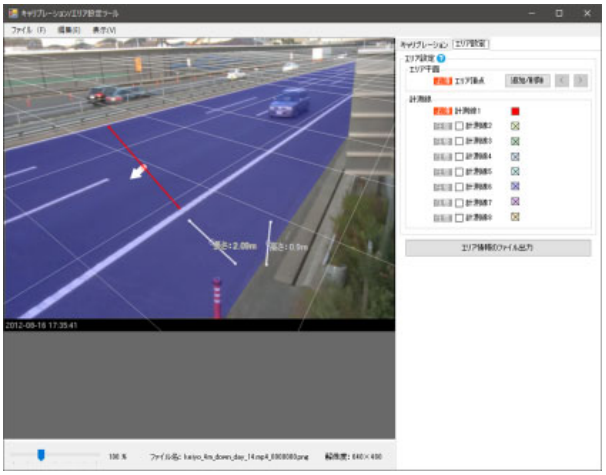

Photo 3. Area/Measurement Line Setup Screen

After the calibration and area/measurement line setups are completed, a setup file is created. When this file is uploaded to the AE2100, the vehicle sensing function is ready for operation.

(4) Measurement result display

The measurement result after operational startup can be viewed on a web browser by accessing the AE2100 installed at the site from a PC via the network. Furthermore, as shown in **Photo 4**, it is possible to check the aggregated information on the number of passing vehicles, reverse driving vehicles, speeding vehicles, and the average speed of vehicles for each camera.

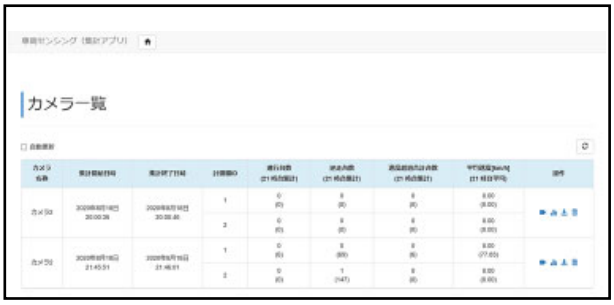

Photo 4. Display of Aggregated Measurement Result

As shown in **Photo 5**, a live image from each measurement camera can be displayed by selecting and operating the image display icon. The trajectory of detected vehicles and the measured speed immediately after crossing the measurement line can be displayed.

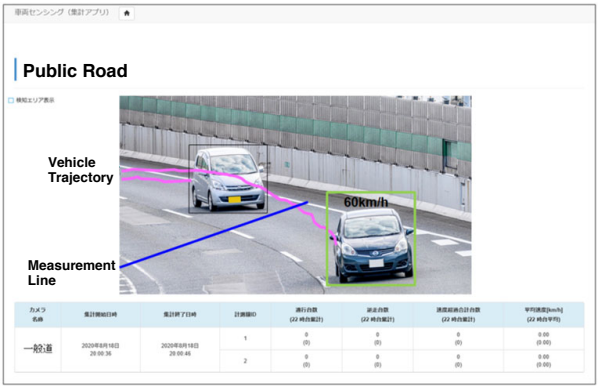

Photo 5. Display of Camera Image

Additionally, when the graph display icon is selected, the measurement result on the number of passing vehicles, reverse driving vehicles, speeding vehicles, and the average speed are displayed as a graph on the web browser as shown in **Photo 6**.

Since the measurement result can be output as a CSV file, the system user is free to process, modify and graph the data using Excel*4).

Photo 6. Graph Display

(5) Demonstration experiment

The previous sections explained five AISION Vehicle Sensing System functions, the setup operation and measurement result display.

In developing the system, OKI conducted a demonstration experiment for over a year with the purpose of sending warnings to vehicles violating safety on the company premise. Through the demonstration experiment, knowledge was accumulated on vehicle sensing functions (AI learning model) suitable for actual operation and camera installation/adjustment. Detection accuracy was improved to a level that enables operation under adverse conditions such as night, rain and snow. Reduction in the number of vehicles violating safety on the company premise was also confirmed.

Conclusion

The AISION Vehicle Sensing System is the result of the accelerator-equipped AI edge computer (AE2100) for AI edge processing and AI-based traffic counter made possible with OKI's deep learning[1] as well as expertise and detection accuracy built up through a demonstration experiment lasting more than a year.

The AISION Vehicle Sensing System prevents accidents caused by unsafe driving and reduces the burden of safety management work. It can be used in various places from private premises to public roads contributing to ensure the safety of travelling vehicles.

In the future, OKI will promote cooperation with partners through the ecosystem, strive to expand AISION solutions to various fields other than travelling vehicle management, and contribute to solving social issues by providing safety and security through advanced image monitoring using AI. ◆◆

References

1) Akitoshi Tsukamoto, Takamitsu Watanabe, Sho Isobe: AI-based Traffic Counter, OKI Technical Review, Issue 234, Vol.86 No.2, pp.20-23, December 2019 (in Japanese)

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*4) Excel is a registered trademark or trademark of Microsoft Corporation in the United States and other countries.