

Solution Brief

IoT Traffic Management and Enforcement
AI License Plate Recognition System



DFI and Chunghwa Telecom Labs Deliver Solution to Help Reduce Traffic Accidents

DFI and Chunghwa Telecom Labs chose the Intel® Distribution of OpenVINO™ toolkit to create a mobile AI system that can identify license plates of vehicles committing traffic violations



“The model optimization on Intel® processors is outstanding. You can take full advantage of multicores and flexibly set the number of threads used.”

—Jarry Chang, director of product, DFI

Image recognition system helps law enforcement officers reduce accidents

DFI and Chunghwa's solution assisted Nantou County Police Bureau in identifying 26 vehicles in just one month, helping to reduce often-fatal accidents.

Serious traffic accidents and fatalities in Taiwan increased by more than 55,000 between 2014 and 2020.¹ Vehicles with **deregistered, suspended, revoked, or stolen license plates** have caused many of these crashes. Law enforcement officers have had minimal success identifying and tracking down these vehicles using conventional methods such as watching CCTV footage and patrolling and staking out locations with high incidences of hit-and-run accidents.

While vehicles of all kinds are involved in accidents, Taiwan police consider dump trucks the leading cause of the country's traffic-related deaths. Dump trucks in Taiwan can only travel on certain roads, requiring them, for example, to avoid residential neighborhoods and other densely populated areas. However, many dump trucks and other vehicles violate these restrictions and also use deregistered license plates. Counties throughout Taiwan need new solutions to help identify these vehicles because conventional methods are inefficient, require too many officers, and are time consuming.

At the request of Taiwan's Nantou County Police Bureau, DFI and Chunghwa Telecom Labs jointly developed an AI-based system using the DFI ES220-CS IoT edge node, which is built around an 8th/9th Gen Intel® Core™ processor. DFI-Chunghwa's system captures photo and video images and recognizes license plates in near-real time, using an AI algorithm developed by Chunghwa with the OpenVINO™ toolkit. This portable and compact license plate recognition system allows county police officers to go almost anywhere to identify the license plates of dump trucks and other vehicles.

Benefits

Law enforcement officers can identify vehicles that are using deregistered license plates and violating traffic laws

With the ability to quickly identify the license plates of these vehicles, even a short-staffed police force can help prevent potentially fatal hit-and-run accidents. DFI-Chunghwa's AI license plate recognition system makes it possible for police departments to ban, confiscate, and impound previously elusive vehicles.

Streamlined deep learning inference

The OpenVINO toolkit optimizes AI inference across a range of Intel ingredients, including CPUs, VPUs, GPUs, and implementations across cloud architectures and edge devices, including DFI ES220-CS.

Flexible, compact, rugged, and portable image recognition system

The system is modular with components that fit easily into a carry-on rolling suitcase. Users can travel nearly anywhere to capture and upload photographs and videos of vehicle license plates in near-real time.



Challenges

The integrated CPU/GPU processor design from Intel allowed DFI and Chunghwa to create a streamlined and scalable solution. They built the system around the DFI ES220-CS and the 8th/9th Gen Intel Core processor to achieve reliable, scalable CPU performance for AI inference. Intel® architecture allows the system to execute high-performance AI calculations by relying on the CPU and its integrated GPU alone. The Intel Core processor significantly reduces network and storage burdens by supporting hardware encoding, ensuring the efficiency of edge to cloud data verification. For scale, DFI ES220-CS is a multislot system supported by Intel's compact hardware design—allowing users to add additional processors as needed.

Weather, smog, and vehicles traveling at high speeds can corrupt or distort an image or video. To capture and process high-resolution photos and video, DFI and Chunghwa chose the [Sony IMX385LQR](#) that captures high-resolution images under challenging conditions. Chunghwa's AI image processing algorithm helps ensure image fidelity, clarity, and precision.

Power demands for AI image recognition models can significantly reduce the battery life of mobile systems. With the power consumption efficiencies of the Intel Core processor, the mobile license plate recognition system can run on a standard power brick. With thermal design power (TDP) of 35 watts, the CPU can process 1920 x 1080 resolution at 60 frames per second for license plate recognition inference. This low power consumption allows the system to run on a USB-based external power supply with 20,000mAh for up to three hours.²

Algorithm and application development can be time consuming, especially with complex code that may need to be rewritten for different processors. Chunghwa Telecom Labs created their algorithm using the OpenVINO toolkit with its write once, deploy anywhere design. OpenVINO also simplifies the inferencing path with streamlined development and accelerated AI workflows.

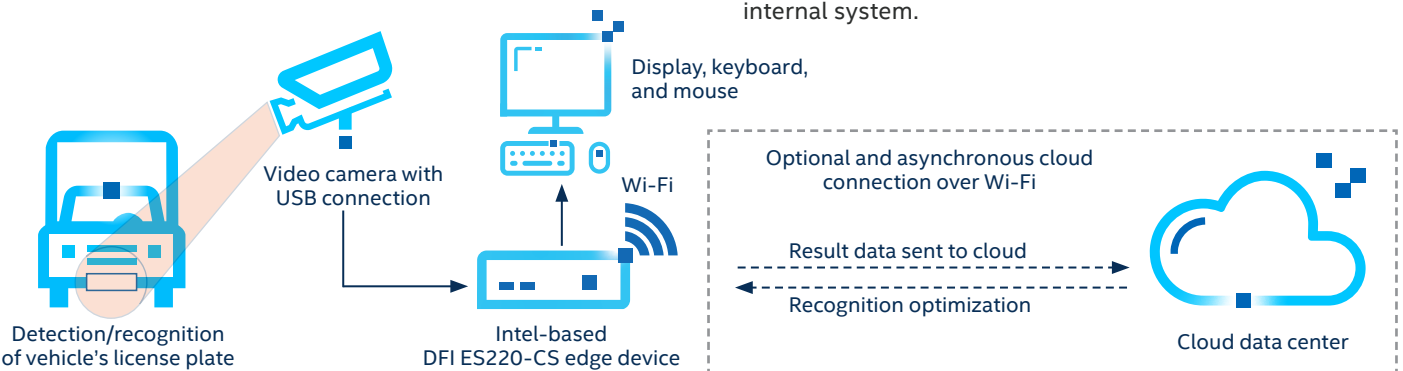


Figure 1: The system captures high-resolution video or photos of a license plate to help law enforcement rapidly identify vehicles involved in traffic violations.

Solution: AI image processing helps police rapidly ID vehicles suspected of traffic violations

Using the OpenVINO toolkit, Chunghwa Telecom Labs developed an AI algorithm that can rapidly perform deep learning inference on images, making it possible for police to identify often-deregistered license plates of vehicles in Taiwan. The algorithm is embedded in DFI ES220-CS, an edge device that stores and processes the photographs and video images of license plates police capture with the system.

Components of the DFI-Chunghwa Telecom Labs' AI license plate recognition system

- [DFI ES220-CS edge device](#), powered by an 8th/9th Gen Intel Core processor
- Chunghwa Telecom Lab's AI image processing algorithm
- [Sony IMX385LQR image sensor](#)
- Tripod
- Mouse, ruggedized LCD, keyboard
- External USB power source
- Wi-Fi dongle
- Rolling suitcase, standard carry-on size

How it works

DFI and Chunghwa's solution generates near-real-time license plate recognition using the system's AI image processing algorithm.

- Officers set up the system in hotspots that have been prone to accidents often caused by dump trucks traveling in restricted, highly populated areas. Police can set up the system nearly anywhere—on the side of the road, from the window, on the hood of a police car—or secure it to a telephone pole.
- The camera captures video or photographs of the license plates of vehicles suspected of violating the law.
- Via Wi-Fi, the system immediately sends images or video of the license plate to the police bureau's secure cloud.
- The captured images are only stored on the computing host, the DFI ES220-CS. The camera captures video or photographs only of the license plates of vehicles suspected of violating the law. The system does not capture any photographs or videos of drivers.
- In compliance with privacy regulations, police query driver information independently through the department's internal system.

“With OpenVINO™ toolkit, we were able to rapidly develop and deploy our AI algorithm. The performance on the Intel® hardware platform exceeds most open source libraries.”

—Wei-Yuan Cheng, researcher, Business Solution Laboratory, Chunghwa Telecom Labs

Conclusion: Near-real-time image recognition system helps reduce accidents; more applications coming

The DFI-Chunghwa Telecom AI license plate recognition system, powered by an Intel® processor and the OpenVINO toolkit, is now a highly valued accident reduction solution for Taiwan's Nantou County. Police departments in other counties throughout the country also plan to adopt the system. While DFI and Chunghwa built their AI license plate recognition system to assist law enforcement, they

envision that other industries could use it as well. Examples include environmental and employee safety monitoring in industries including government and manufacturing and additional traffic-monitoring and parking applications. As the system evolves, DFI and Chunghwa will continue to rely on Intel's IoT, smart road infrastructure, and vertical market expertise.

Learn more

[Learn more about the AI license plate recognition system ›](#)

[Watch the DFI webinar about AI license plate recognition ›](#)

For more information about IoT smart infrastructure powered by Intel, visit intel.com/roadinfra.



Intel Distribution of OpenVINO toolkit

OpenVINO toolkit is a complete development platform for deploying AI on x86 architecture. It optimizes and converts deep learning models into high-performance inference engines that can run on any mix of Intel® hardware.

Developers can choose between standard support releases or Long-Term Support (LTS). Standard releases provide new versions of the toolkit every quarter, ideal for early-stage projects and developers looking to take advantage of the latest innovations in deep learning. LTS offers long-term maintenance and support, a great choice for later-stage developers focused on leveraging the toolkit's existing features and functionality.

Find out more at intel.com/opencvino.

About Chunghwa Telecom

Chunghwa Telecom Co., Ltd., founded in 1996, is Taiwan's largest provider of domestic, international, fixed, mobile, broadband, and internet services. Chunghwa Telecom Research Labs deliver information and communication services and innovative technology services such as the Internet of Things (IoT) and artificial intelligence.

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About DFI

Founded in 1981, DFI is a leading supplier of high-performance computing technology worldwide. DFI uses the latest technology platforms and manufacturing techniques to produce cost-effective products for medical diagnostics and imaging, ATM/POS, industrial control, kiosk, security and safety, digital signage, gaming, and other embedded applications. As a member of the Intel® Partner Alliance, DFI collaborates with Intel on developing next-generation standards-based building blocks, platforms, and solutions for the communications and embedded market segments.

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1. Traffic fatalities source: National Police Agency, Ministry of the Interior, Taiwan, <https://www.npa.gov.tw/en/app/data/view?module=wg055&id=8026&serno=8c0583a6-675c-4cf6-8647-781dbcf9f523>.
2. Source: Chunghwa Telecom Labs internal testing.

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