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Delivering Reliable Edge AI ALPR Solution for Fixed and Mobile Traffic Enforcement



Intelligent Transportation System (ITS) deployments demand reliable plate capture and recognition at highway speeds using LPR cameras. However, real-world deployments must contend with high-speed motion blur, inconsistent plate formats, night-time glare, weather variability, multi-lane capture, evidentiary accuracy requirements, and locations with limited power or network infrastructure.

e-con Systems® partnered with a U.S.-based ITS and enforcement solutions provider to deliver the reliable **Edge AI ALPR System** optimized for fixed and mobile roadside deployment. The solution combined purpose-built camera hardware and ALPR accuracy optimization on an embedded vision SoC. This enabled high capture accuracy at low latency with minimal infrastructure.

This case study outlines the client's challenges, system requirements, and how e-con Systems delivered a rugged, solar-capable ALPR solution ready for large-scale deployment.

About the Client

The client is a U.S.-based provider of ALPR and traffic enforcement solutions. Delivering high-accuracy vehicle identification, license plate recognition (LPR), and speed enforcement data to law enforcement agencies and traffic authorities.



Client Requirements

The client faced several challenges commonly encountered in fixed/mobile ALPR deployments, particularly in enforcement scenarios operating outside controlled environments. To ensure consistent performance and scalability, the solution needed to meet the following requirements:

- **High capture accuracy** at vehicle speeds and distances up to ~150 feet in multi-lane traffic
- **Integrated Radar** for speed measurement
- **ALPR processing** on embedded vision SoC
- **2MP imaging** optimized for plate capture
- **Integrated high-output IR illumination** for night-time and low-light operation
- **Low power design** with battery and solar panel support
- **Rugged, compact enclosure** suitable for fixed or mobile deployments
- **Designed to align with U.S. traffic enforcement** workflows and evidentiary image capture requirements

Our Solution

e-con Systems delivered a complete edge-based ALPR camera system – optimized for accuracy, reliability, privacy and ease of deployment in infrastructure-constrained environments. The solution came with camera hardware, optics, edge processing platform, radar-based speed sensor & an ALPR software engine all integrated inside an IP rated enclosure. This delivered a fully integrated ALPR platform ready for fixed and mobile enforcement deployments.

- **Radar** for vehicle detection and speed extraction
- **External trigger and strobe support** to ensure precise image capture
- **Digital I/O** for integration with external sensors

Major Components of e-con Systems' Solution

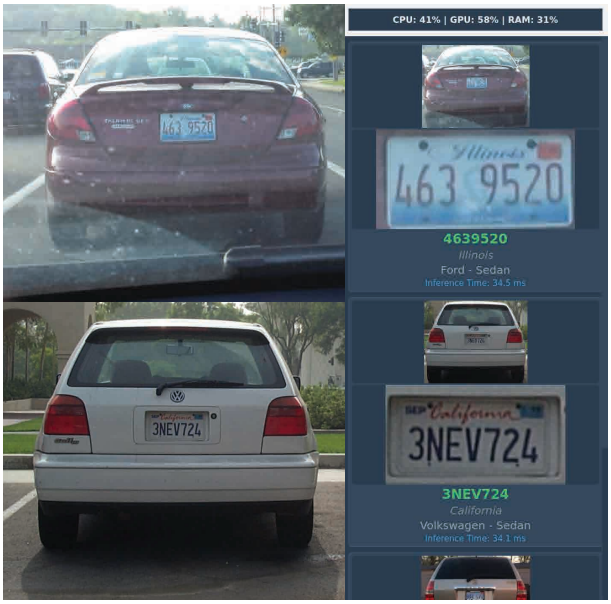
Dual-Camera Hardware Architecture

e-con Systems delivered a dual-camera ALPR design comprising

- **2MP color global shutter camera** for daytime capture and vehicle attribute extraction
- **2MP monochrome global shutter camera** optimized for IR-based night vision & license plate capture
- **High-output IR illumination,** synchronized with the camera

This architecture ensured stable plate visibility across lighting conditions while enabling recognition of vehicle make, model, color, and type during both daytime and nighttime operation.

e-con Systems' cameras were integrated into a compact, rugged enclosure – perfect for pole-mounted (fixed) and quick-deploy (mobile) installations.



ALPR Accuracy Optimization

Beyond hardware integration, e-con Systems worked closely with the client to improve real-world ALPR performance through **software and algorithm-level optimization**, including:

- ISP tuning to enhance plate contrast and manage reflectivity
- Image Quality optimization for capturing blur-free images of high-speed vehicles
- IR illumination alignment and intensity tuning
- ALPR Algorithm parameter tuning to reduce false positives & missed detection

As a result, the system consistently achieved **>98% capture and recognition accuracy** in live traffic conditions, including at highway speeds.



Edge Processing Platform

e-con Systems' ALPR cameras were deployed as part of a complete edge AI system. This enabled the client to:

- Run ALPR and vehicle analytics locally at the edge
- Reduce bandwidth and cloud dependency
- Manage real-time alerts and enforcement workflows

Therefore, the system could help recognize:

- License plate number and issuing state
- Vehicle make, model, and color
- Vehicle type and direction of travel
- Vehicle speed
- Vehicles without visible license plates
- Support for multiple traffic enforcement scenarios (red light, wrong way, parking violations, etc.)



Privacy, Security & Data Protection

To support responsible data practices, the solution also incorporated privacy-preserving features critical to public safety & regulatory compliance:

On-device face anonymization

Automatic blurring of pedestrians and driver faces at the edge before storage or transmission

Selective object masking

Ability to redact non-relevant objects or identifiers from scene captures

These features help law enforcement and civic stakeholders comply with evolving data protection norms while maintaining enforcement effectiveness.

Power, Connectivity & Durability

The solution came with features such as:

- **Low-powered operation** with support for a battery and solar panel
- **Dual power input:** 12V DC and PoE+
- **Wired (PoE+) & Wireless (LTE) connectivity** for simplified installation
- **IP68-rated enclosure** with military-grade aluminum housing
- **Inert-gas filled enclosure** for enhancing internal stability in outdoor roadside environments
- **Operating temperature range**: -34°C to +74°C (NEMA TS2)

Hence, the solution could handle challenging roadside environments for a range of roadside enforcement and monitoring scenarios, including:

- Speed detection and enforcement
- Wrong-way and lane violation detection
- Multi-lane free-flow traffic monitoring
- Incident and congestion monitoring
- Community safety and traffic studies

Furthermore, the solution could be easily deployed (temporary or permanent), allowing rapid installation without fixed power infrastructure.

Business Benefits

High-accuracy ALPR

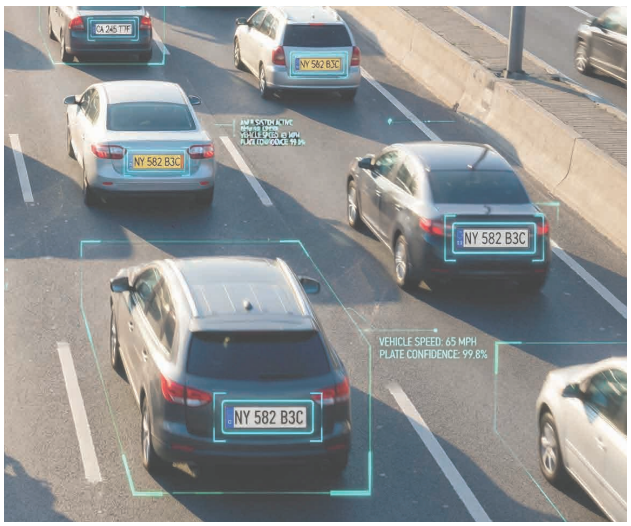
The dual-camera architecture, combining IR-optimized and color imaging along with ALPR tuning, delivered reliable license plate capture and recognition at highway speeds, even in low-light and adverse weather conditions.

Field deployment–ready & faster Time to Market

While the customer initially approached e-con Systems for camera modules, we delivered a complete Original Design and Manufacturing (ODM) solution combining camera hardware, edge processing, connectivity, and ALPR software.

This significantly reduced system integration effort and validation. By supporting required U.S. certifications, the solution accelerated time to market and enabled the customer to be ready for large-scale deployment.





BABA-aligned procurement readiness

The customer required Build America, Buy America (BABA) alignment for participation in U.S. transportation RFQs. Leveraging e-con Systems' manufacturing capabilities and local supply partners, the solution was designed to support BABA requirements, helping reduce procurement risk and improve readiness for federally funded projects.

Improved enforcement effectiveness

Reliable plate capture at highway speeds improved violation detection rates while reducing missed events and false positives by 10 - 20%, effectively increasing the identification of actual violators.

Let's Connect

Want to explore how an ANPR System can enhance the performance of your tolling or traffic enforcement applications, and intelligent traffic management applications?

Connect with the experts who worked on this solution:

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About e-con Systems

e-con Systems® designs, develops, and manufactures OEM cameras and complete vision solutions with over 20 years of embedded vision expertise. We focus on delivering solutions to industries such as retail, medical, industrial, agriculture, smart city, and more.

e-con Systems' wide portfolio of products includes Time-of-Flight cameras, MIPI camera modules, GMSL cameras, USB cameras, stereo cameras, GigE cameras, low light cameras, and more. Our cameras are currently embedded in over 350+ client products. So far, we have shipped over 2 million cameras to the United States, Europe, Japan, South Korea, and many other countries.

