



Edge AI在無人機等之應用

義隆電子 葉儀皓



ELAN Microelectronics Corporation

全球無人機市場出貨量預測



Agenda

ELAN Edge AI Key Technologies

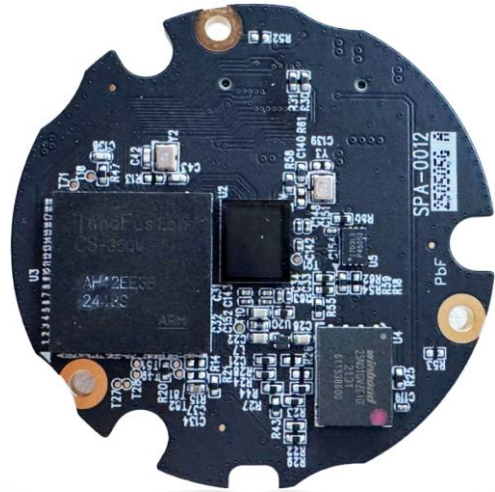
On-Device AI in Drones

On-Device AI in Smart Transportation

On-Device AI in ADAS

Q & A





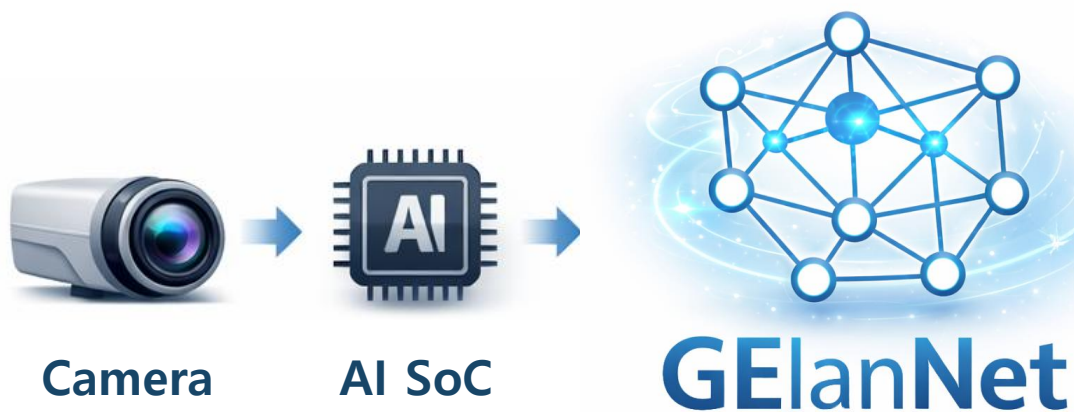
ELAN Edge AI Key Technologies



GElanNet : 義隆在邊緣AI的策略

From Algorithm to Real-World Deployment

Self-Developed Edge AI Algorithm



Co-Developed by



中央研究院
ACADEMIA SINICA



One Edge AI Core Across Multiple Domains



義隆持續和中研院合作全球最快最準AI影像辨識模型YOLOv4/R/7/9

義隆自行開發 On-Device AI 演算法 – GElanNet 只須開源碼1/2的算力

Server-based (open Source)

CSPNet (2019)
Google Citation: 5,311
FWCI: 334.30

YOLOv4 (2020)
Google Citation: 21,487
FWCI: 無

Scaled-YOLOv4 (2021)
Google Citation: 2,064
FWCI: 67.96

YOLOR (2023)
Google Citation: 811
FWCI: 8.14

YOLOv7 (2023)
Google Citation: 11,238
FWCI: 988.33

YOLOv9 (2025)
Google Citation: 2,173
FWCI: 1138.67

Edge AI

Edge Module

Jetson TX2: 1.33
TFLOPS (7.5W)

Jetson Xavier NX:
21 TOPS (15W)
ElaNetv2

AI-SOC:
2-TOPS (<4W)
GElanNet

相關論文已被引文(Citation)超過1萬次！

Computer Science > Computer Vision and Pattern Recognition

[Submitted on 27 Nov 2019]

CSPNet: A New Backbone that can Enhance Learning Capability

Chien-Yao Wang, Hong-Yuan Mark Liao, I-Hau Yeh, Yueh-Hua Wu, Ping-Yang Chen, Jun-Wei Hsieh

Neural networks have enabled state-of-the-art approaches to achieve incredible results on computer vision tasks such as with cheap devices from appreciating the advanced technology. In this paper, we propose Cross Stage Partial Network architecture perspective. We attribute the problem to the duplicate gradient information within network optimization. the end of a network stage, which, in our experiments, reduces computations by 20% with equivalent or even superior the MS COCO object detection dataset. The CSPNet is easy to implement and general enough to cope with architecture

Computer Science > Computer Vision and Pattern Recognition

[Submitted on 21 Feb 2024 (v1), last revised 29 Feb 2024 (this version, v2)]

YOLOv9: Learning What You Want to Learn

Chien-Yao Wang, I-Hau Yeh, Hong-Yuan Mark Liao

Today's deep learning methods focus on how to design the most appropriate acquisition of enough information for prediction has to be designed. Existing This paper will delve into the important issues of data loss when data is transferred (PGI) to cope with the various changes required by deep networks to achieve be obtained to update network weights. In addition, a new lightweight network that PGI has gained superior results on lightweight models. We verified the performance achieve better parameter utilization than the state-of-the-art methods developed train-from-scratch models can achieve better results than state-of-the-art models



陳良基的創新筆記

2021年12月13日 · 1

台灣在科技界的新世界第一！

感謝中研院、義隆電子、台大AI中心所有研究團隊的投入，也恭喜廖所長傑出優異的帶領！這是個可以改變世界的新技術。

<https://www.ithome.com.tw/article/148305>



ITHOME.COM.TW

臺灣製造！世界第一物件偵測AI

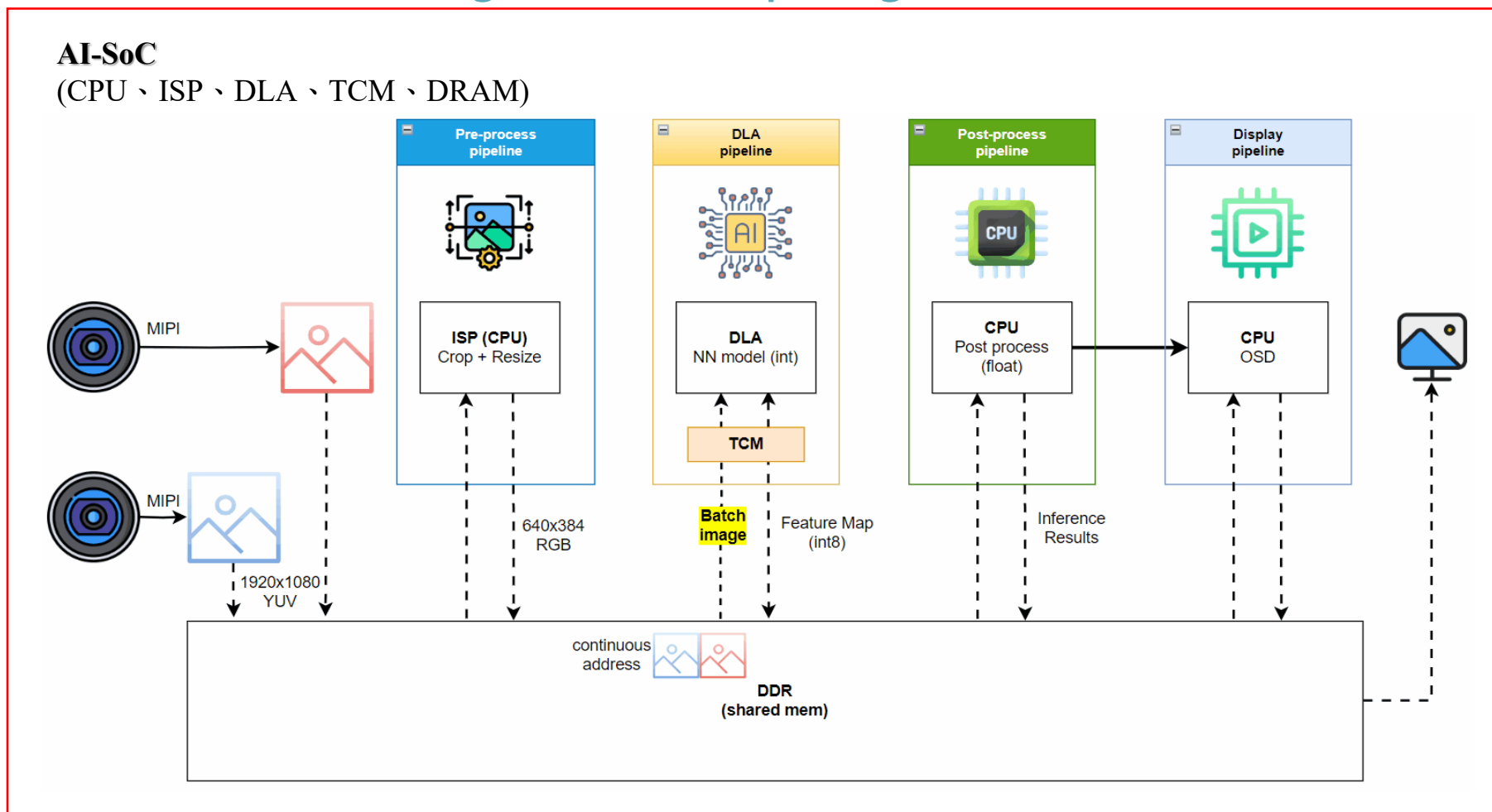
ELAN Collaboration with
Academia Sinica



義隆AI演算法是依應用場景及異質運算SoC架構限制下最佳化的模型

義隆配合AI晶片硬體限制自行開發 On-Device AI 演算法 – GElanNet 只須開源碼1/3的算力

異質運算(Heterogeneous Computing) : CPU及GPU之間的運算



TCM(Tightly Coupled Memory) DLA(Deep Learning Accelerator)

GElanNet :為實際應用而生的邊緣AI

YOLO-Level Vision, Optimized for On-Device Deployment



Based on

YOLOv4

YOLOR

YOLOv7

YOLOv9



Compute Efficiency ✓

YOLO-Level, 1/3 Compute



Power Efficiency ✓

Low Power, Built for Edge



Small Form Factor ✓

Fits on Device



Low Cost ✓

Production-Ready

資料收集是很重要的,沒有收集到的資料就是以後偵測的盲點

半數追撞事故車裝有輔助駕駛系統！



在AI產品開發流程,很重要的是如何收集各種應用情境的資料庫

AI只會考古題,沒有訓練過的資料,未來應用時就不準,且要注意資料的平衡

常態資料

影像情境

Day_time

Weather

Driving_Scene

{ 白天
黃昏/清晨
夜間
室內 }

{ 晴天
陰天
雨天 }

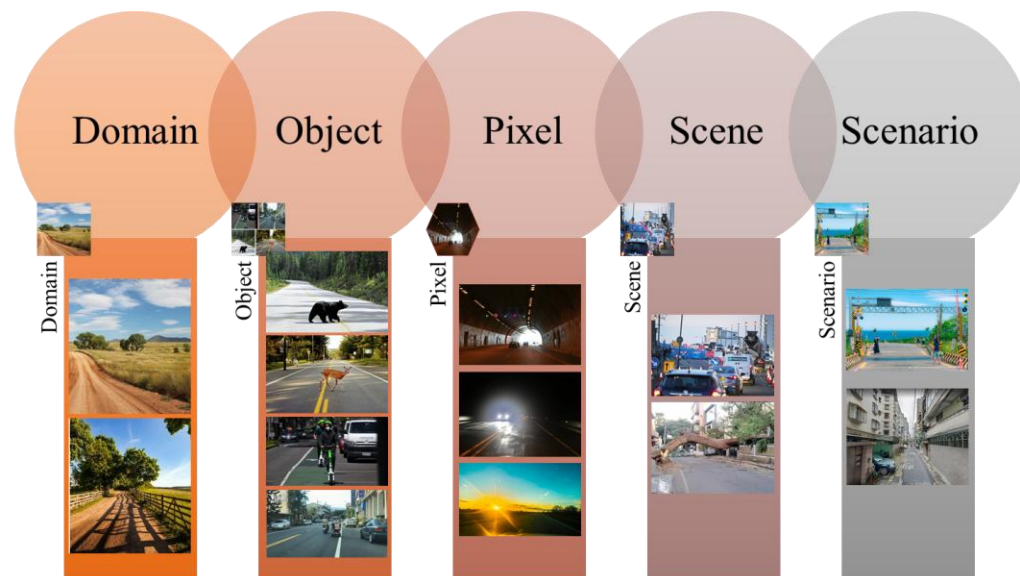
{ 高速/快速道路
鄉間
市區
其他 }

物件定義:

小車、大車、機車(含騎士)、自行車(含騎士)、行人、機車、自行車

須注意資料平衡的問題
Data Balance

Corner Case資料



1. Domain-level: 鄉間、雪地、低光源
2. Object-level: 動物 (AR)、行動輔具
3. Pixel-level: 出隧道的逆光、太陽西曬、夜間對向車燈
4. Scene-level: 擁擠物件(Rush hour)、道路施工、樹倒在路上/人倒在路上等(AR)
5. Scenario-level: 平交道、小巷弄

義隆使用 AR/GAI 進行 Data Augmentation 資料擴增情境生成之應用

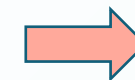
AR產生特殊情境/物件 (資料擴增)



GAI AR產生特殊情境/物件(資料擴增)



魚眼鏡頭
基於物件
生成



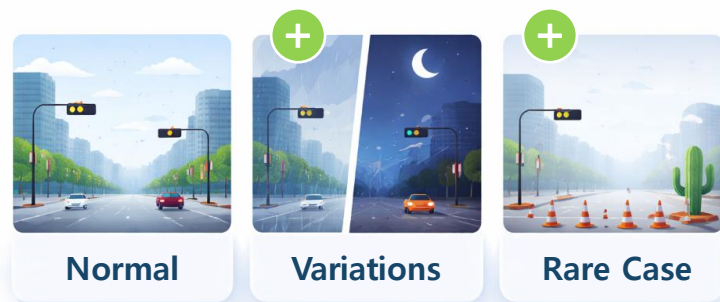
基於場景-
添加特殊車輛、更改天氣狀況



圖片生成影片



GElanNet 設計流程



AR / GAI Data Augmentation

Synthesizes Rare
Scenarios — Lighting,
Weather, Edge Cases



Active Learning

Selects Only The
Highest-value Samples
for Labeling



Knowledge Distillation

Compresses Large
Model Accuracy
into Soc-friendly Size



AI × Drone

Intelligent Unmanned
Aircraft Systems



結合義隆AI技術的智慧無人機應用



AI-Powered Drone Vision
Recognition System

AI Target Detection & Tracking
Obstacle Avoidance



Power Saving



Compact Size



Ultra-Lightweight



Lower Cost



Extended Flight Range



多旋翼無人機 Skydio X10 避障/雲台與 ELAN的比較

Skydio X10

NVIDIA Jetson Orin (275 TOPS)
Obstacle Avoidance

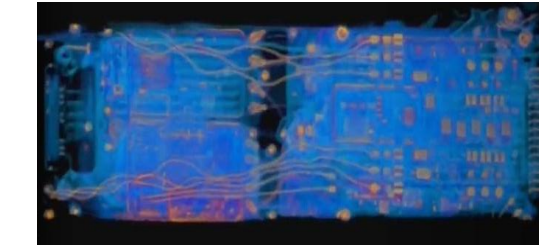


6 Cameras

Qualcomm QRB5165 (15 TOPS)
Gimbal



3 Cameras



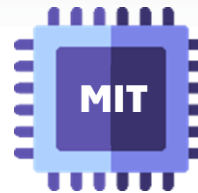
PCB Size –
3505 x 1651 x 1194 mm

Obstacle Avoidance (8 TOPS)



PCB Size - 60 x 57 x 2 Pcs

ELAN Solution



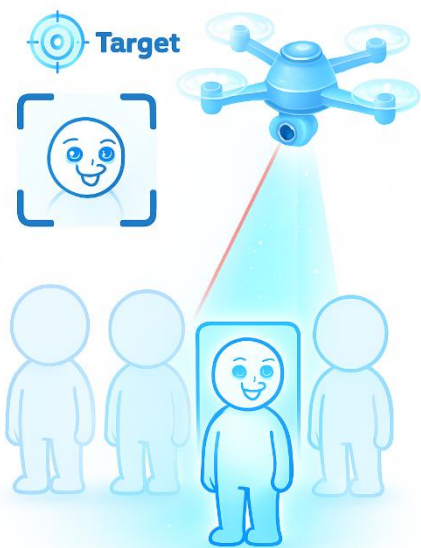
Gimbal (2 TOPS)



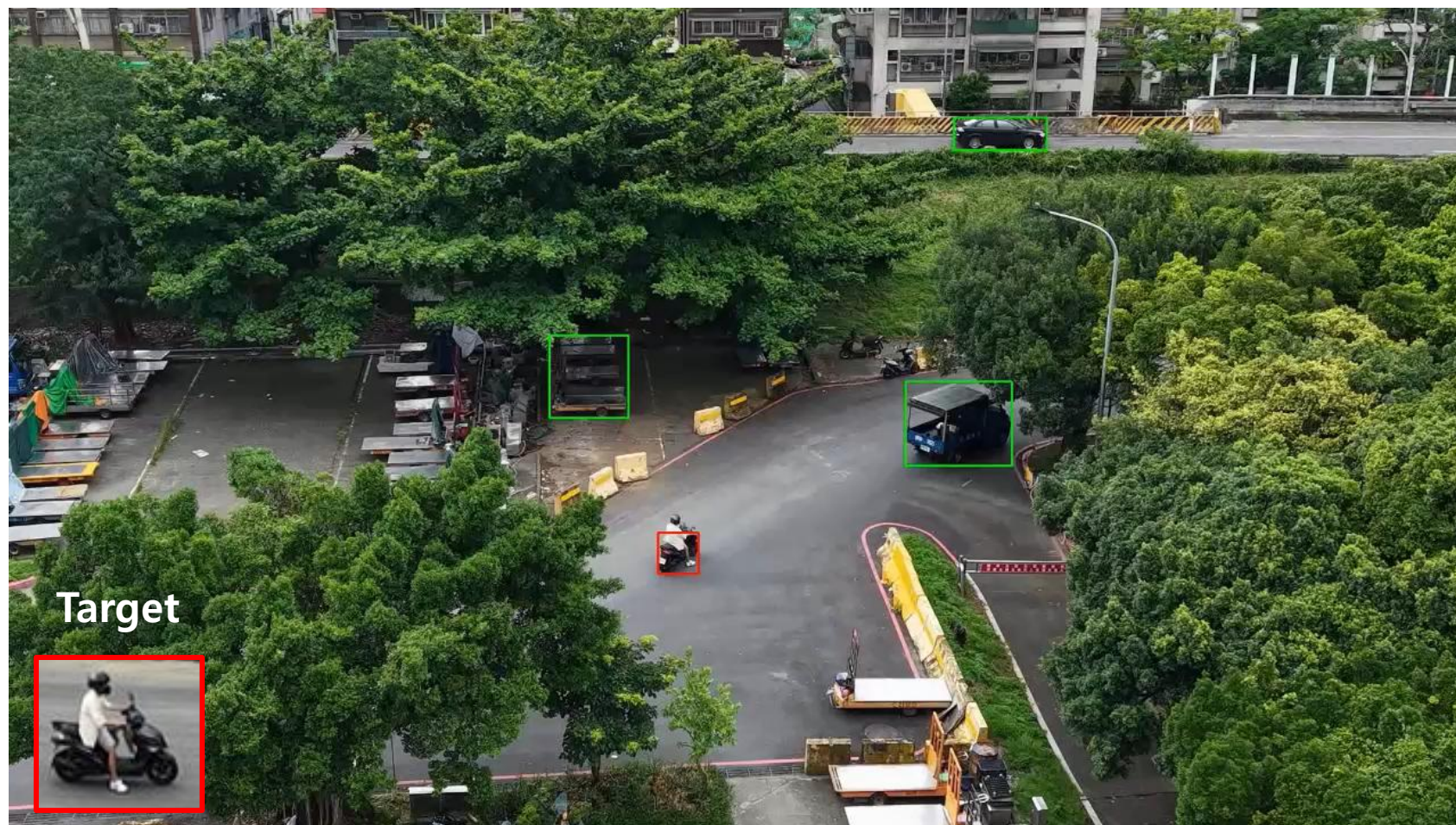
PCB Size - 38 x 38 x 3 Pcs

義隆無人機雲台 - AI目標物件偵測與追蹤的方案

AI Target Detection & Tracking



- Accurate Target Lock
- Higher Mission Efficiency



義隆無人機雲台 - 現正開發夜視AI目標物件偵測與追蹤的系統

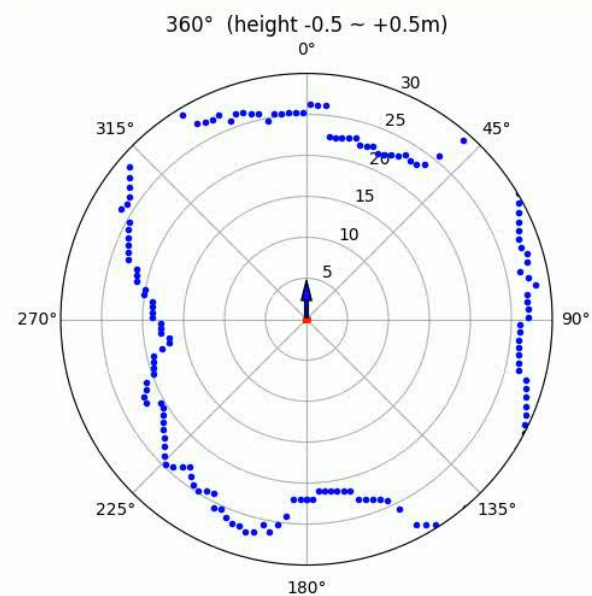
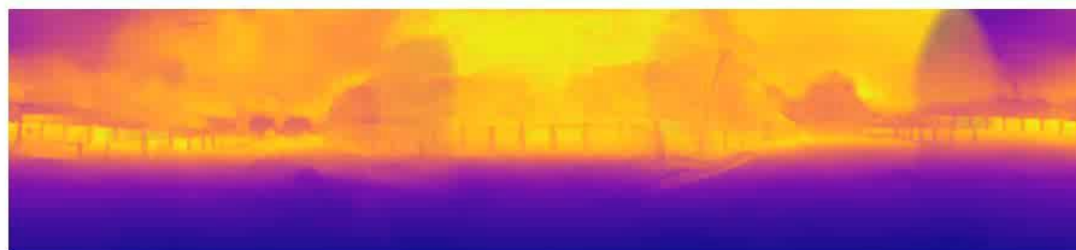
人的眼睛看到



Sensor=0.001 Lux



義隆無人機避障－環景深度估計



義隆Mini LED Local Dimming及觸控技術應用於地面控制器

High Contrast and Power Efficiency for Drones in Outdoor Light

Mini-LED Local Dimming



>4000nits
High Brightness



>20000:1
High Contrast



>600
HDR



Power Saving
Extended Battery Life

ELAN AI × Touchscreen



Glove Touch
Cotton / Thick Glove ✓



Waterproof
Rain / Seawater / Outdoor ✓



Frozen Touch
Extreme Weather / Frost ✓



ELAN Mini-LED Local Dimming



義隆Image Signal Processor (ISP) 應用於無人機

Wide-Angle Correction and HDR for FPV-Class Drones (甲類無人機)



- Wide Horizontal FOV 150°
- Lens Distortion Correction
- Analog Output Clarity
- Enhanced Dark Detail
- Full-Color Night Vision

ISP Image Signal Processor Chip

鏡頭畸變校正



(A)校正前



(B)校正後

鏡頭除霧



(A)處理前



(B)處理後



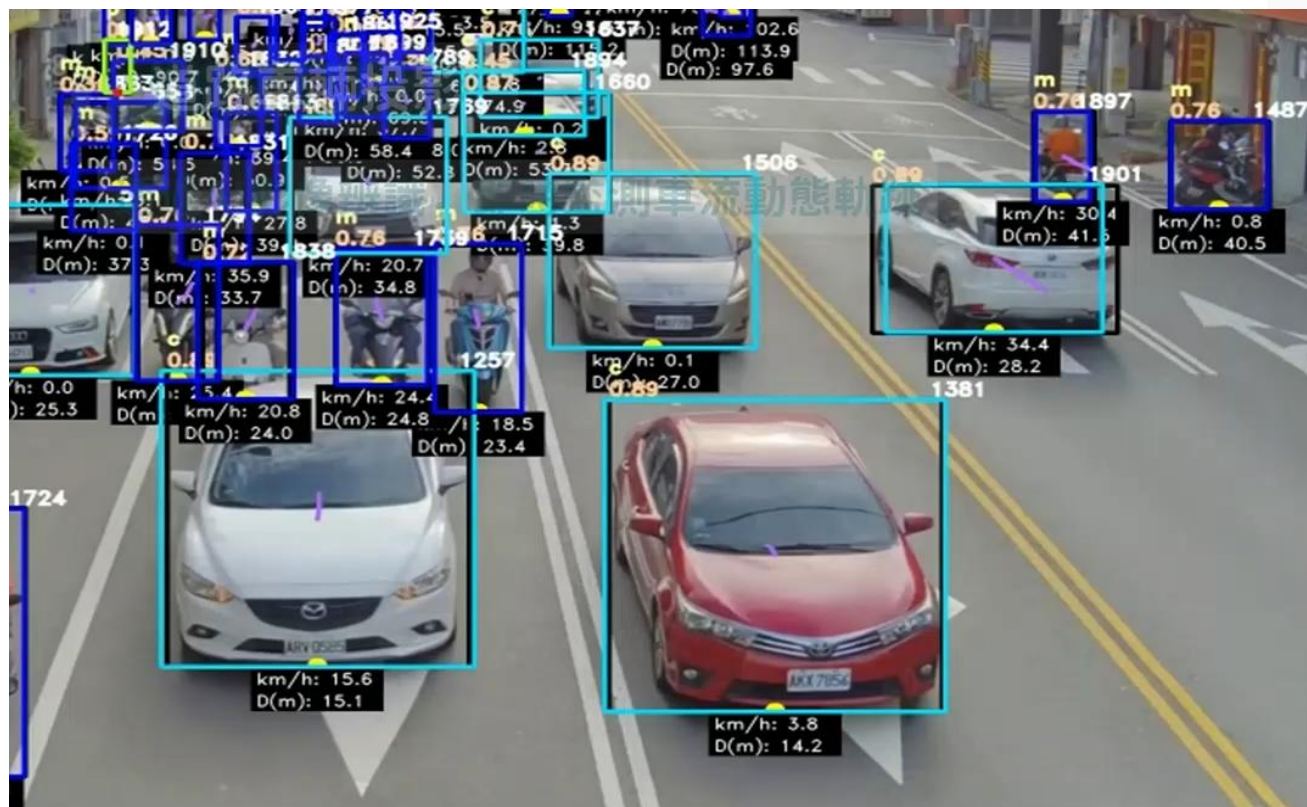
AI × ITS

Intelligent Transportation
System



義隆AI CCTV即時交通資訊蒐集系統-提供車速/座標投影及預測闖紅燈

- 即時偵測車輛至停止線距離、車輛位置、速度等資訊



**Millisecond-Level
Traffic Flow Detection**



AI RL Traffic Signal Algorithms

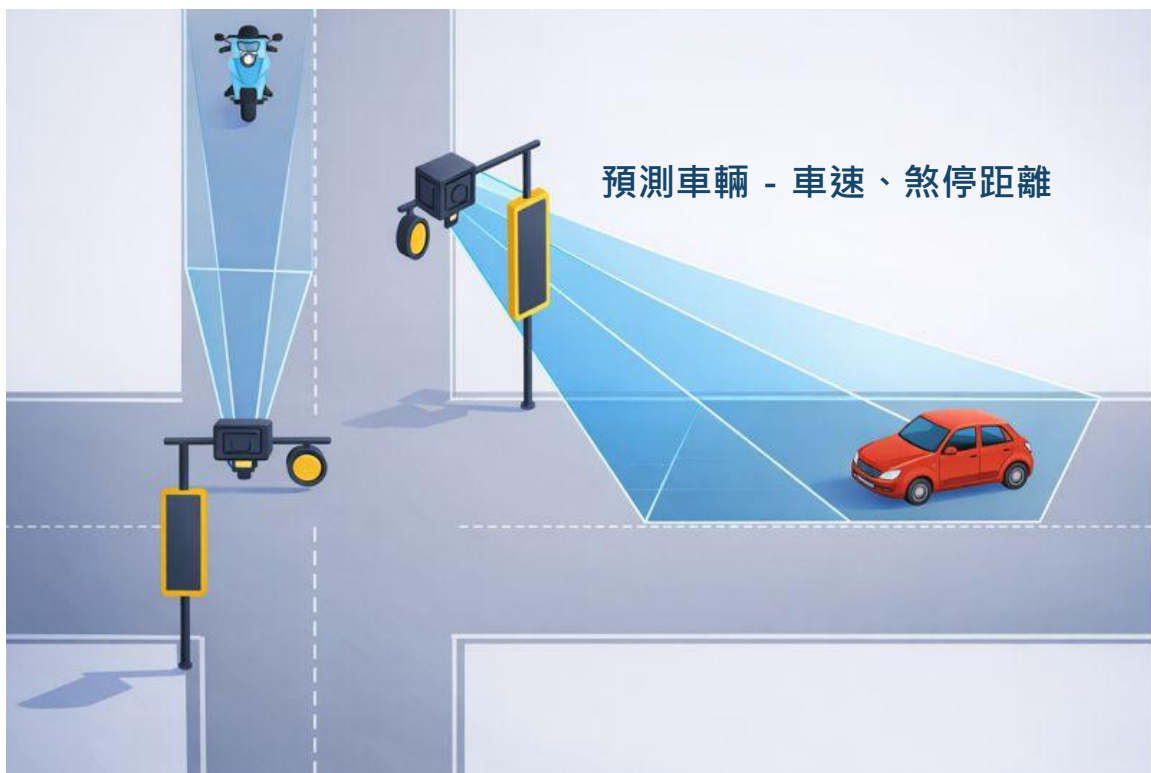


**Edge-Based Dynamic
Traffic Signal Control**



義隆 Real-Time AI CCTV 闖紅燈預測及於無號誌路口應用

- 即時偵測車輛到路口時間
- 預測可能事故發生時提示黃燈轉紅燈



- 闖紅燈預測

橋墩影響視距



義隆Real-Time AI CCTV 弱勢用路人即時智慧安全系統

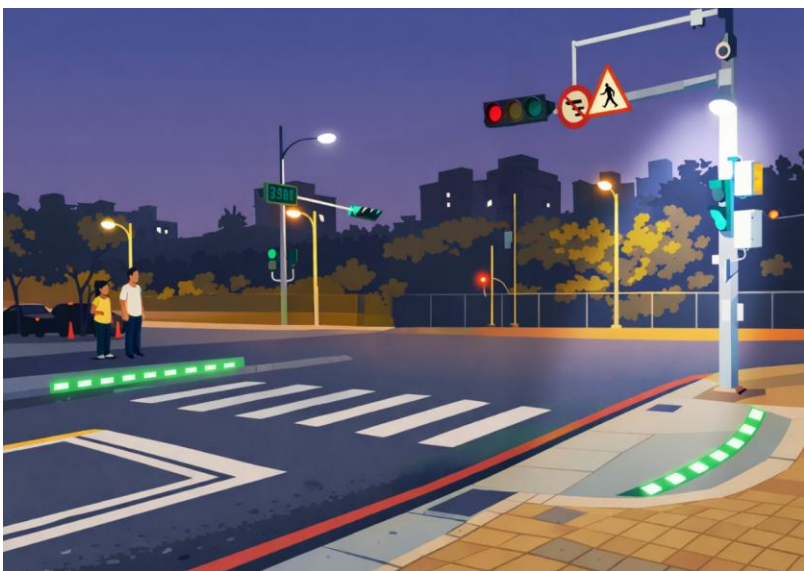
安全告警 - 即時AI影像辨識，提醒行人注意來車、提醒來車注意行人

行人靠近斑馬線

*地面燈 - 亮綠燈

*照明燈 - 點亮開啟

*警示牌 - 無開啟

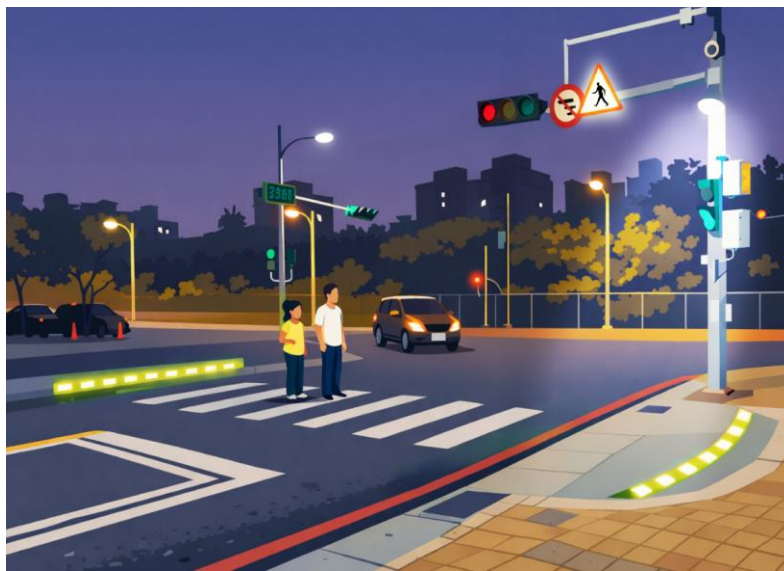


斑馬線上有行人通行時，且有車輛靠近時

*地面燈 - 亮黃燈

*照明燈 - 點亮開啟

*警示牌 - 點亮開啟

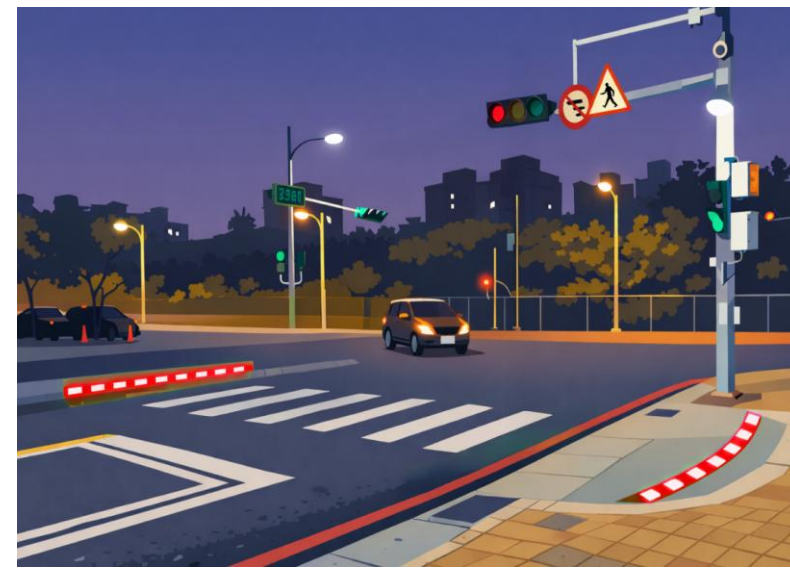


斑馬線上無行人通行，只有車輛行駛

*地面燈 - 亮紅燈

*照明燈 - 無開啟

*警示牌 - 無開啟



賴總統宣示 2050 人行道
0 死亡擺脫行人地獄

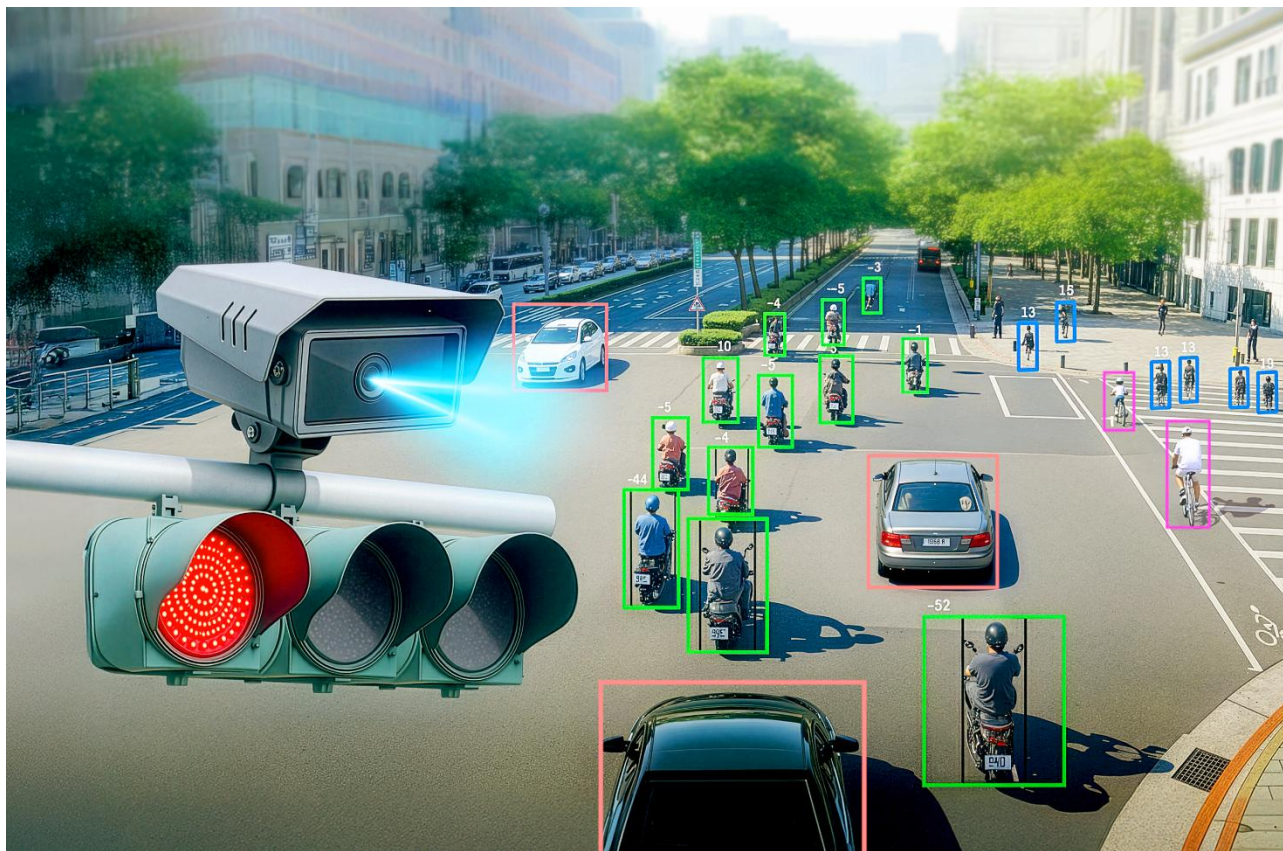


Edge-based Pedestrian
AI Safety System
邊緣端行人AI安全保護系統



結合AI的監控與智慧運輸解決方案

Low Latency · Low Power Edge AI for Pedestrian Safety



Real-Time Traffic Information
Collection System

AI RL Based Adaptive Traffic
Signal Control System

Smart Safety System for
Vulnerable Road Users

ELAN ITS Solutions Honored
at COMPUTEX Taipei 2025





關鍵指標拆解：我們如何量化「安全」與「可靠」

評估AI交通監控系統效能的核心標準：涵蓋從攝影機成像品質到AI偵測準確度，再到整體系統穩定性的各項關鍵指標與數據門檻

感知能力：硬體與AI的基礎



影像解析度

100萬 ~ 800萬像素
(1MP - 8MP)

確保基礎辨識能力，並平衡系統處理負擔與成本



> 95%

車輛與行人偵測準確率
(F1-Score)

精準辨識是提升行人安全與交通改善的核心

夜間與惡劣天候下的清晰成像能力



彩色模式

0.10 ~ 0.50 Lux

VS

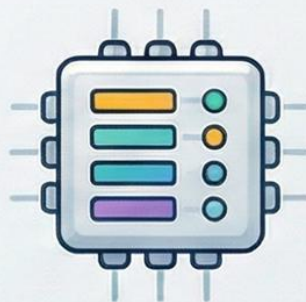


黑白模式

0.01 ~ 0.10 Lux

夜間是事故高風險時段，清晰影像可降低AI誤判率

應用效能：數據與系統的穩定



端到端延遲

60ms ~ 200ms

確保預警系統能即時反應，保障用路人安全。



數據傳輸成功率

> 95% ✓

且支援斷網續傳

確保資料交換順暢，安全功能不因網路中斷。

轉向車流計數準確率 (%)



日間晴天

85% ~ 95%



日間雨天

80% ~ 90%



夜間晴天

80% ~ 90%



夜間雨天

75% ~ 85%

義隆在全球首創 AI 監視器評比中榮獲最高評等

日間晴天 日間雨天 夜間晴天 夜間雨天

頂尖 AI 偵測準確度

車輛偵測

F1 Score
0.9302

行人偵測

F1 Score
0.9238

轉向量偵測：95.29%

停等車輛數偵測96.68%

工業級環境耐受力



IP67
防水防塵等級



運作溫度：
-20°C 至 +60°C

嚴苛環境穩定運作

99.0 /100
綜合評分

在嚴格的測試標準下，獲得近乎滿分的卓越評價。



功耗

5.88W

實測功耗

10/10

能源效率高，低於 7W 標準，
獲得 10/10 滿分。

絕佳的系統效能與穩定性



✓ 即時偵測 (滿分)



✓ 功耗控制 (滿分)



✓ 穩定性 (滿分)



✓ 資料格式 (滿分)



偵測即時性

34.67ms

平均延遲

15/15

反應速度極快，獲得 15/15
滿分評價。



AI × ADAS

Advanced Driver
Assistance Systems



義隆和中研院資訊所合作開發 On-Device AI 演算法 - GElanNet

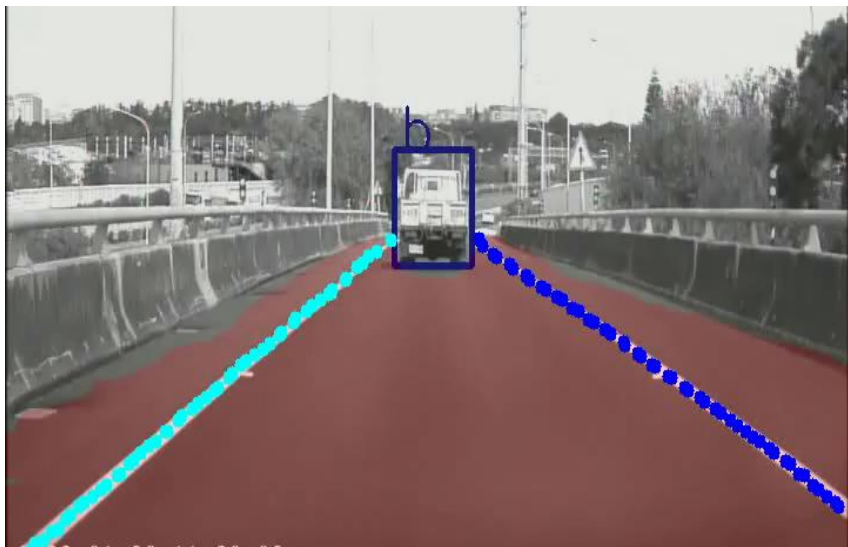
Multi-tasks in Unify Model

單一模型具多功能之演算法

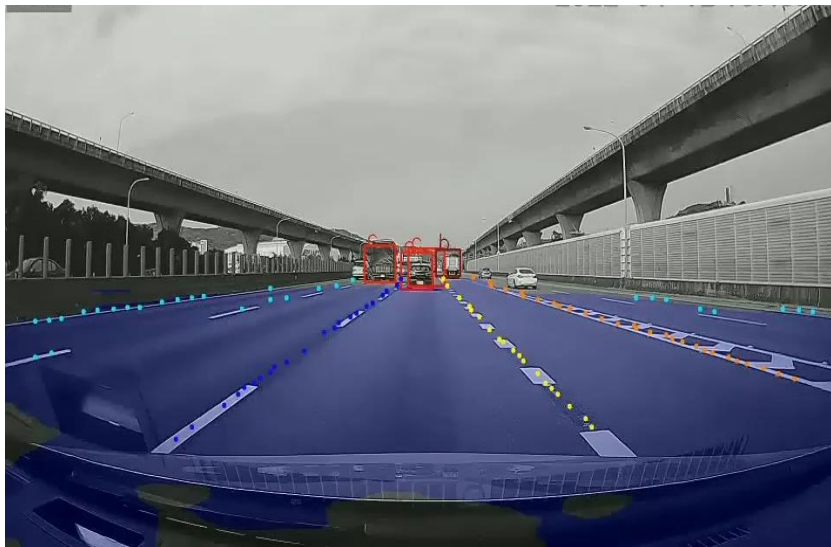


Object Detection + Segmentation + Car-Lane Line

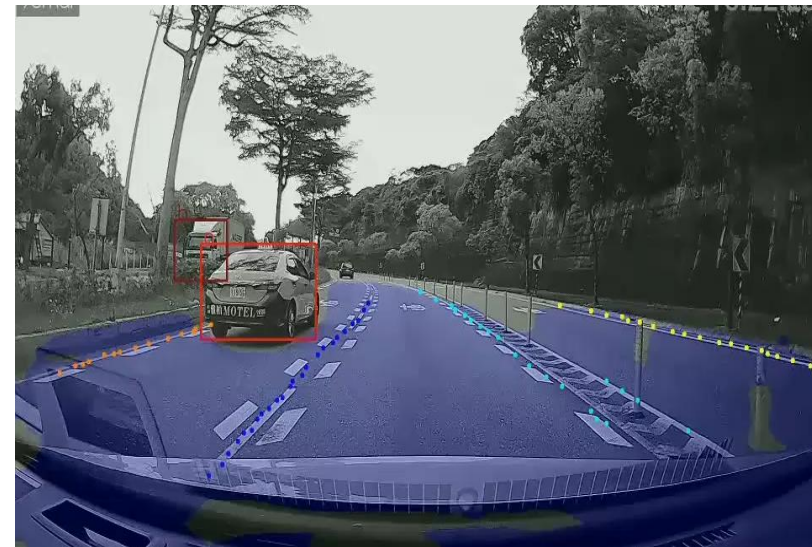
物件偵測及分類+可行駛道路+車道線



Task 1: 道路物件偵測



Task 2: 可行駛道路切割



Task 3: 車道線偵測

GElanNet全面支援各種攝影視角

Front View



Rear View



Side View



In-Cabin View



義隆 AI-enabled ADAS Level 2+ for eBus & Logistics Vehicles



Lane Keeping Assistance (LKA)

Lane Following System (LFS)

Adaptive Cruise Control (ACC)

Autonomous Emergency Braking (AEB)

Emergency Steering Function (ESF)

Automatic Lane Change Assist (ALCA)

Automated Lane Keeping System (ALKS)

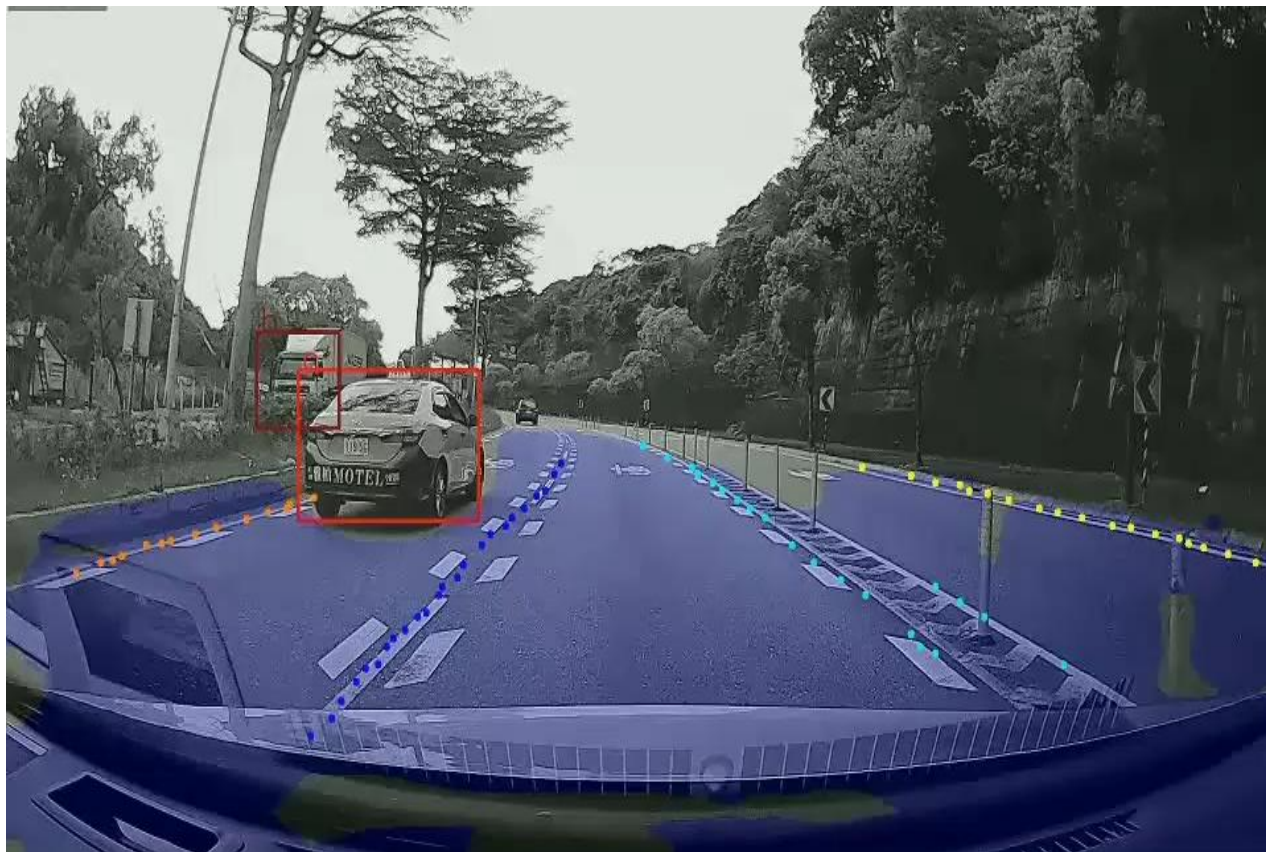
Blind Spot Information System (BSIS)

Camera-Monitor System (CMS)



義隆前方攝影機 AI 先進駕駛輔助系統方案

Front Camera with AI @1 TOPS



Object Detection

+ Drivable Road Segmentation + Car-Lane Line

前方防撞警示 FCW (Front Collision Warning)

車距監控警示 HMW (Headway Monitoring Warning)

車道偏移警示 LDW (Lane Departure Warning)

行人偵測警示 PDW (Pedestrian Detection Warning)

滑溜碰撞警示 SCW (Slide Collision Warning)

前車駛離提示 FMW (Forward Move Warning)

AI多車道線偵測 (AI based Multi-Lane Detection)

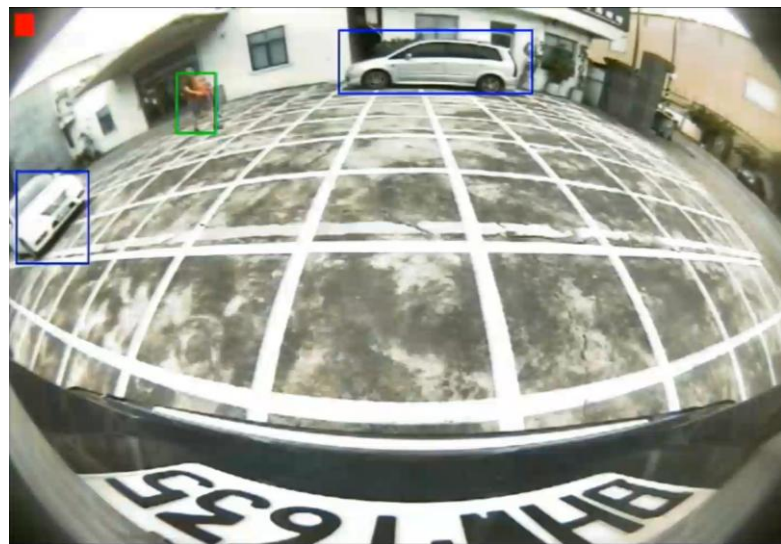
類車道線(路沿)判別 (Road Edge/ Lane Detection)

可行駛道路判別 (Drivable Area Detection)



義隆後方攝影機 AI先進駕駛輔助系統方案(RVS)

倒車模式



行進模式



Rear Fisheye Camera with AI
@ 1 TOPS



後方車側警示系統 RCTA (Rear Cross Traffic Alert)

後方車輛接近警示 BVAW
(Backward Vehicle Approaching Warning)

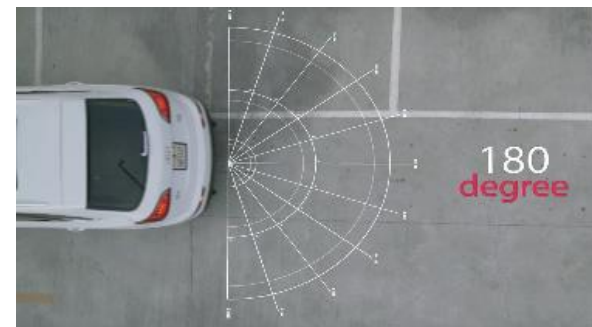
移動物偵測 MOD (Moving Object Detection)

可行駛道路偵測 DRD (Drivable Road Detection)

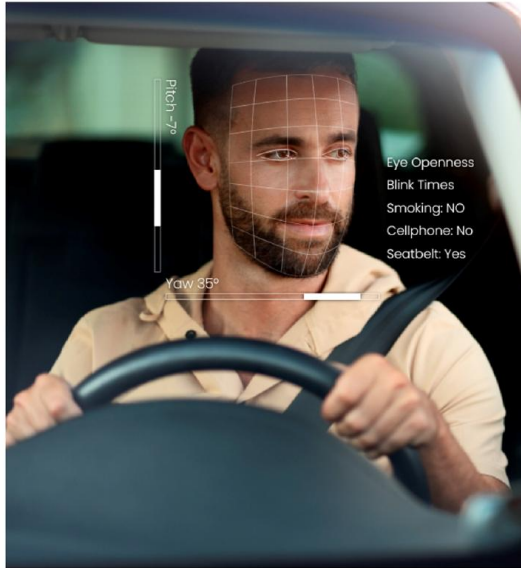
盲點警示 BSW (Blind Spot Warning)

後方車輛追尾碰撞警告 RCW
(Rear Collision Warning)

車門開啟警示DOW (Door Open Warning)



義隆駕駛行為監控系統 (DMS)



DMS

Our Function

 Eye Closing Frequency

 Yawn Detection

 Distraction Detection

 Smoking Detection

 Using Cellphone Detection

 Head Precision Detection

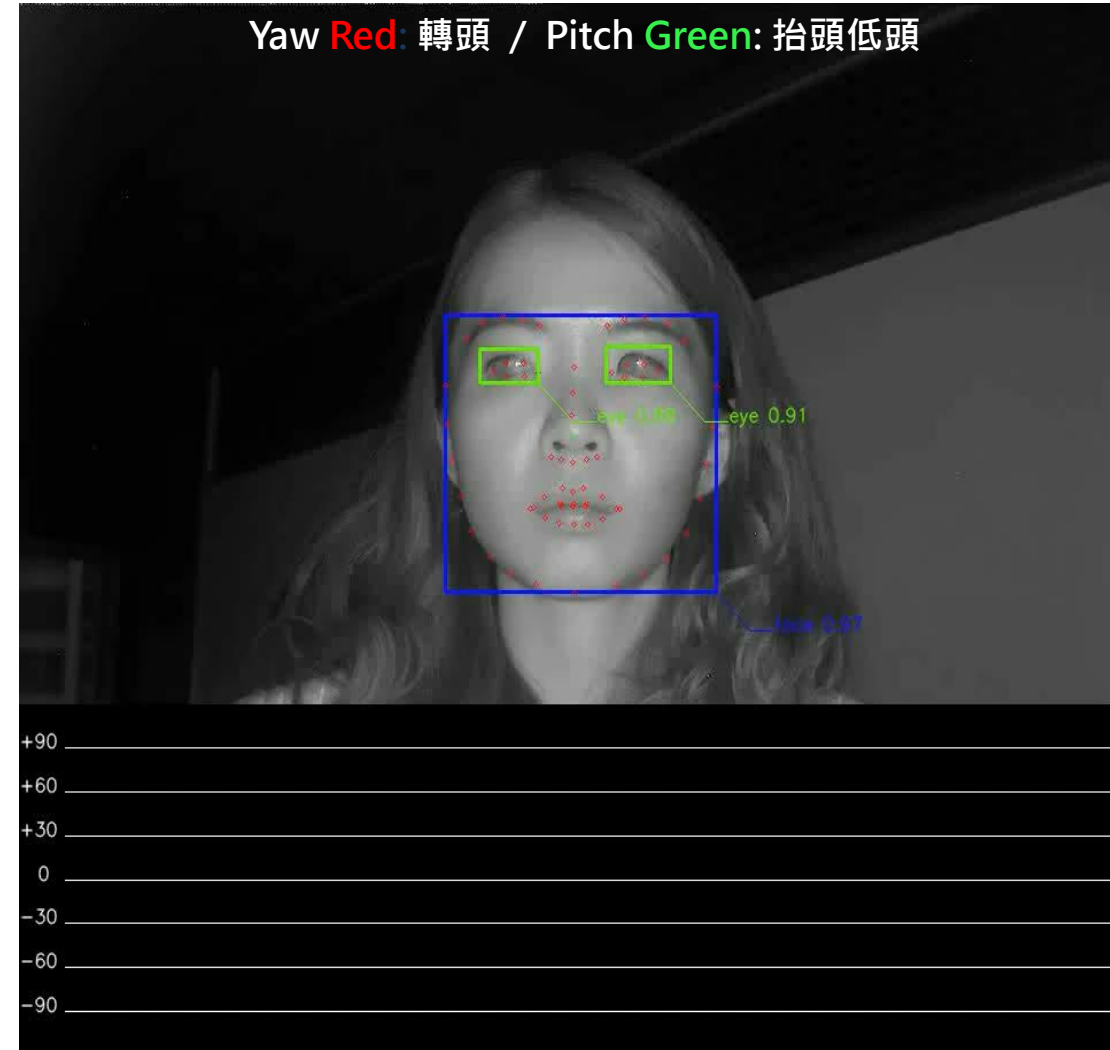
 Gaze Estimation

 Attitude Abnormal Detection

 Seat Belt Detection

Multi-tasks in Unify Model

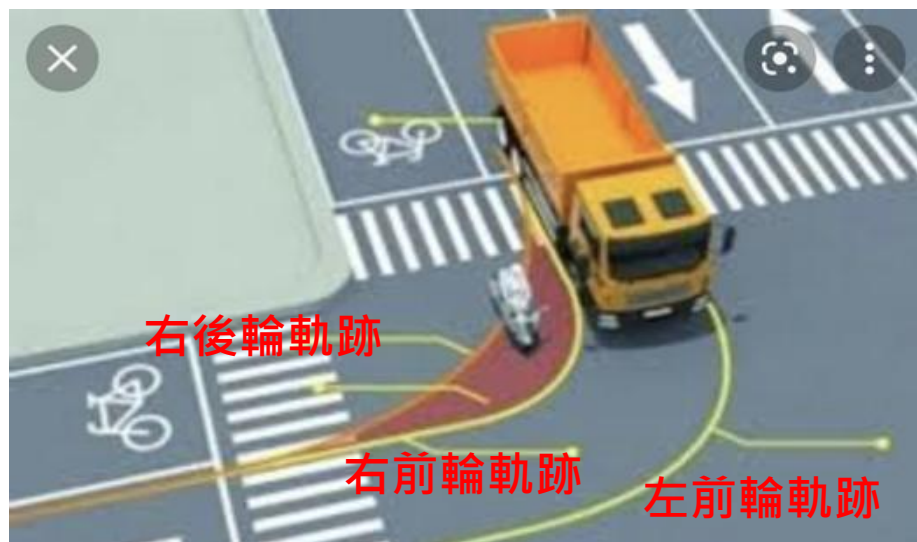
Yaw **Red**: 轉頭 / Pitch **Green**: 抬頭低頭



義隆大型車盲點偵測系統方案(BSIS)



台灣精品
2022



魚眼鏡頭





實證案例二：奇美車電 AI BSIS (大型車盲點偵測)



97.4分

實測分數

關鍵效能實測數據



AI 物件偵測準確度
F1 = 0.9373

高度精準辨識弱勢用路人，
確保主動安全基礎



系統功耗僅 **3.96W**

符合車規設計，不對車用
電力系統造成額外負擔

全方位評測框架



5大類、12項
專業測試

針對AI盲區警示系統進行
滴水不漏的全面性評估



超越國際標準的
UN R151+

強化對台灣常見場景(如近
乎靜止的行人)的偵測能力



挑戰台灣多樣化
道路環境

測試涵蓋日夜情雨四種驗
測天后場景



夜間情境

正確發報率

96%

錯誤發報率
5%



雨天情境

正確發報率

94%

錯誤發報率
5%



正確發報率

100%

錯誤發報率
5%

義隆ADAS Level 2 Solutions



**Enhanced Lane Assistance
Navigator 3.0 (ELAN)**



Lane Following System (LFS)



Emergency Steering Function (ESF)



Electric logistics vehicles



Electric Bus



Agricultural Vehicle



Industrial Vehicle

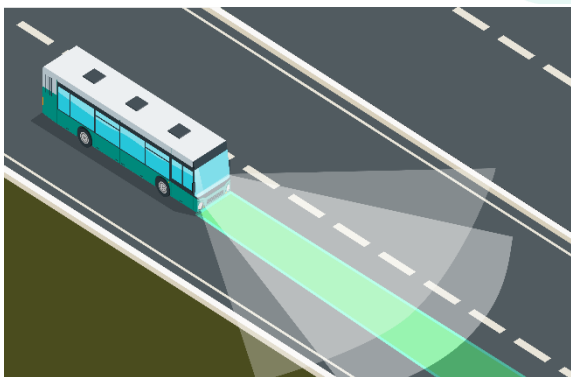
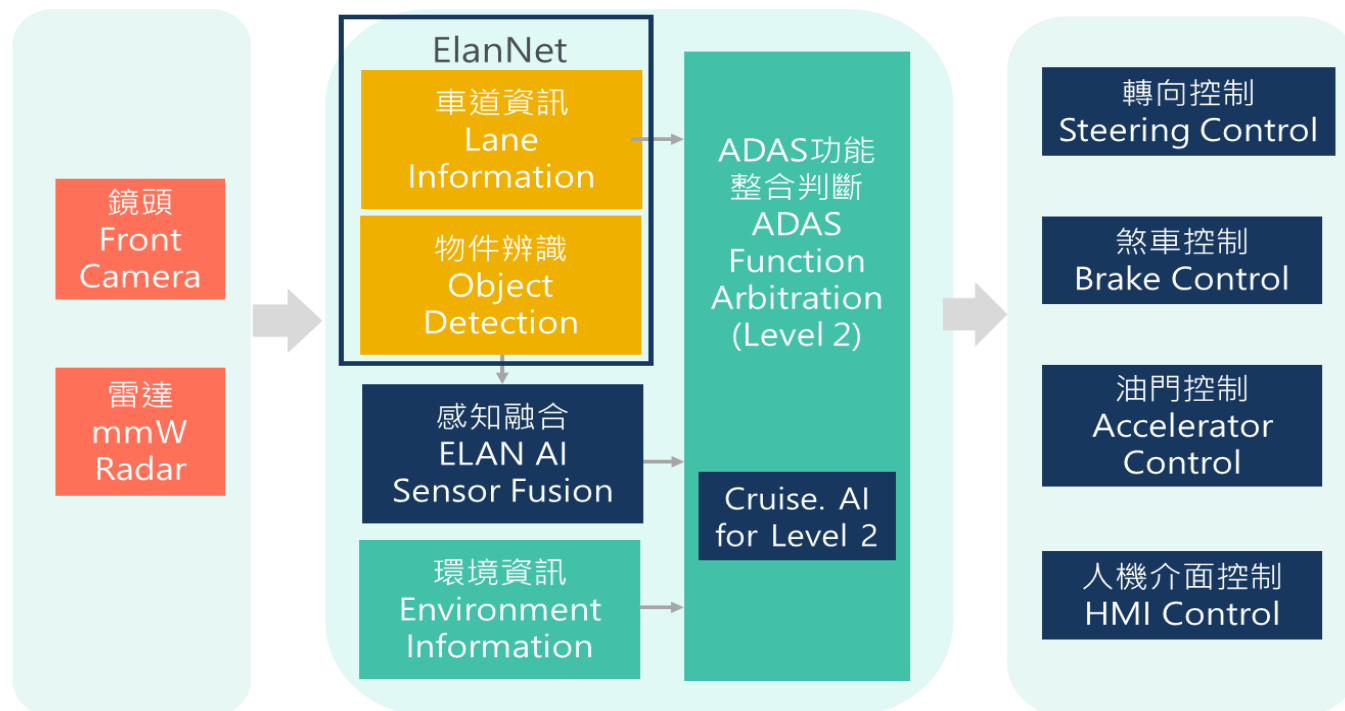


義隆先進駕駛行為輔助系統 ADAS Level 2 應用方案

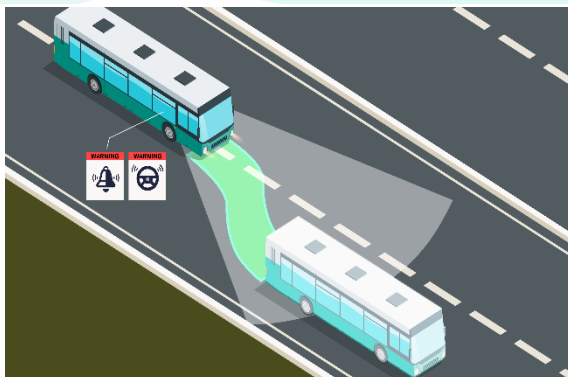
感知 Perception

決策 Decision

執行 Actuator



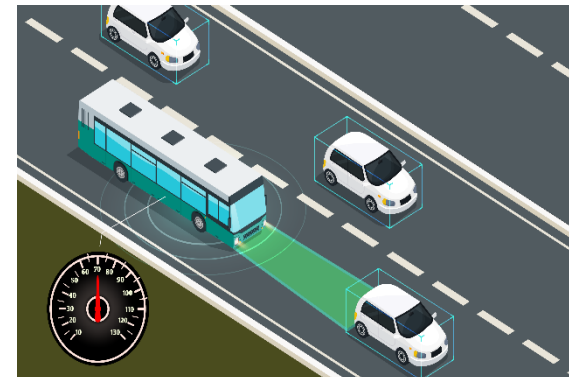
Lane Following System (LFS) 車道跟隨輔助系統



Lane Keeping Assistance (LKA) 車道維持輔助系統

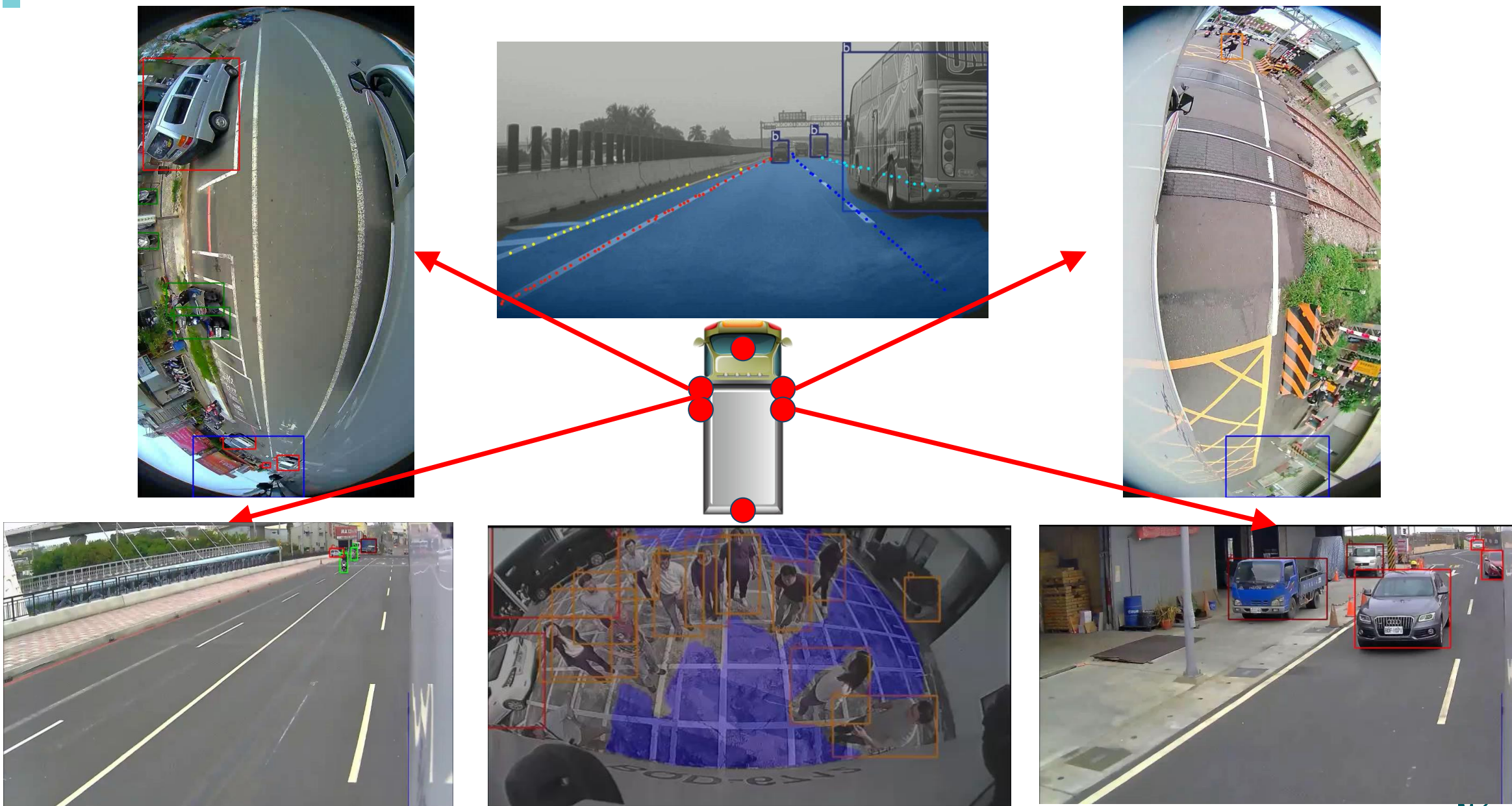


Autonomous Emergency Braking (AEB) 自動緊急煞車系統



Adaptive Cruise Control (ACC) 主動式車距維持系統

義隆 ADAS Level 2+ Camera Perception



義隆目標市場是針對全部視覺影像的應用，目前以攝影機截取圖像後經裝置端 AI 晶片來判斷，其應用包含智慧交通、車用 ADAS、無人機、無人載具及機器人等，義隆和中研院技術合作再衍伸自有研發的演算法 GElanNet，適時扮演裝置端 AI 影像辨識演算法重要核心技術的角色，可以做到低耗電及低成本即輕薄短小。同時利用 AR 及生成 AI 進行 Data Augmentation 擴增各種應用情境的資料庫，讓整個系統的辨識能力大幅提高。



中央研究院
ACADEMIA SINICA



Q&A

