AI-based Vehicle Recognition Solution (Beyond ALPR)

April 2022

NEXTLab

AI-based Vehicle Recognition Solution

(Beyond ALPR)

CONTENTS

(1) Established in 2012
(2) Unique AI & Vision based QoE measurement technologies

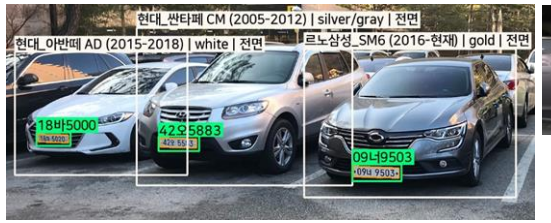
Network & Broadcasting

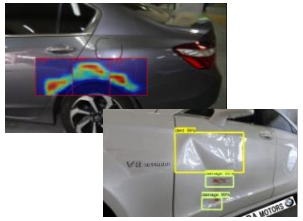
STB Multimeter

netMeter

SK broadband SK telecom LG U+ kt

Vehicle Recognition





HYUNDAI AutoEver AJ셀카 Nanum Company KSI

2. Solution – (1) Main Service

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- Beyond ALPR is an AI-based vehicle recognition solution that extracts and provides information which customers need using only car photos and videos.

License Plate Recognition

(1) **License Plate Type Recognition**
– Responds to license plate display type changes

(2) **License Plate Text Recognition**
– Vehicle license number/text recognition

Vehicle Type Recognition

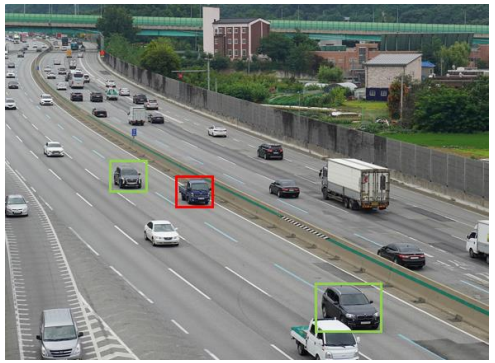
(1) **Vehicle Brand Recognition**
– Identifies vehicle manufacturer company

(2) **Model Recognition**
– Identifies vehicle model by manufacturer

(3) **Year Recognition**
– Identifies manufactured year by model

(4) **Color Recognition**
– Identifies mainly used 13 vehicle colors

Highway Monitoring with Drones



(1) **Real-time Vehicle Type Recognition**

(2) **Real-time Lane Recognition**

(3) **License Plate Recognition and Automated Reports**
– Report vehicles violating traffic laws automatically

Exterior Damage Recognition

(1) **Vehicle Exterior Form Recognition**
– Recognizes damaged parts

(2) **Damage Area and Type Recognition**
– Locates damaged area, and identifies damage types such as scratches and dents

Vehicle Underpart Damage Recognition

(1) **Vehicle Underpart Imaging Solution**
– Simple imaging by camera without using vehicle lifts

(2) **Vehicle Underpart Damage and Area Recognition**
– Recognizes scratches, rusty areas, and leaking parts

2. Solution – (2) Algorithm Structure

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- **The algorithm is subdivided into stages to satisfy various environments and requirements, and combined as needed to form the entire algorithm structure**

- All algorithms by stage responds robustly to environment change through state-of-the-art deep learning technology
- Customers can freely adapt the accuracy and processing speed according to purpose of use (real-time verification, mobile-based recognition, etc.)
- Vehicle recognition is also possible in photos and videos taken using smart phones wherever you are

〈 Vehicle photo/video input 〉

Check if it is FAKE

OBJECT DETECTION

OCR

CLASSIFICATION

Damage detection

〈 Vehicle recognition result 〉

(1) Check if it is FAKE

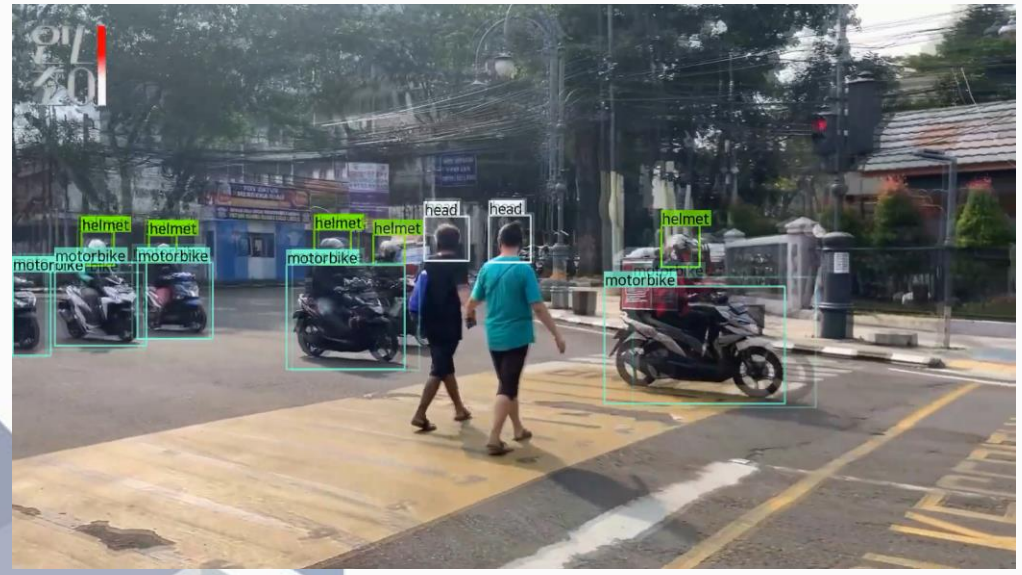
(2) Vehicle frame/license plate recognition

(3) License plate/vehicle type/color recognition

(4) Check for exterior damage

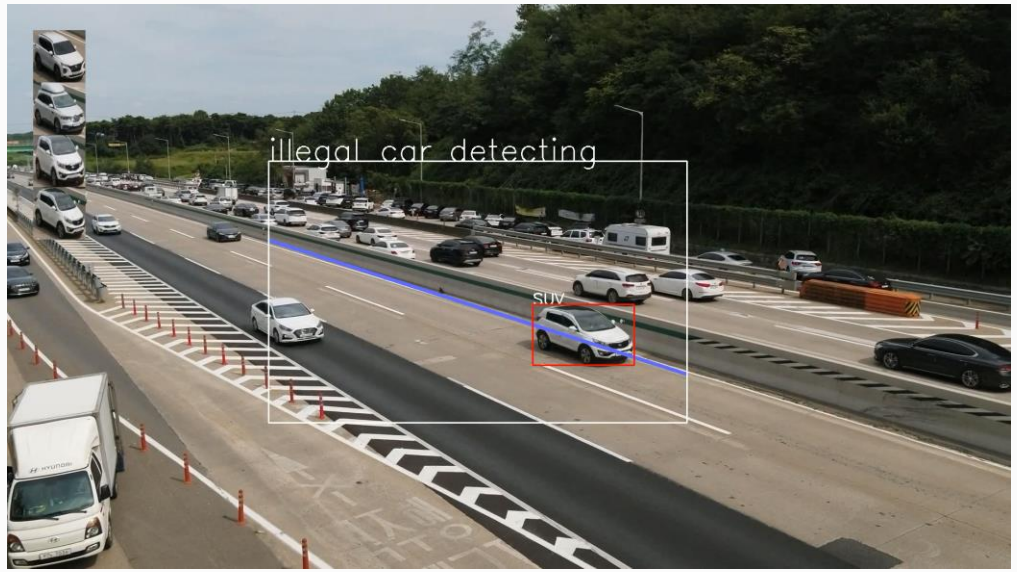
3. Use Case (For PT Mandira Jaya Abadi)

- With the current technology, it can distinguish motorbikes and whether drivers are wearing helmets or not
- Combined technology of lane recognition and license plate recognition gives you information on traffic law violation, whether drivers are wearing helmets or not, and whether passengers are wearing seat belts or not



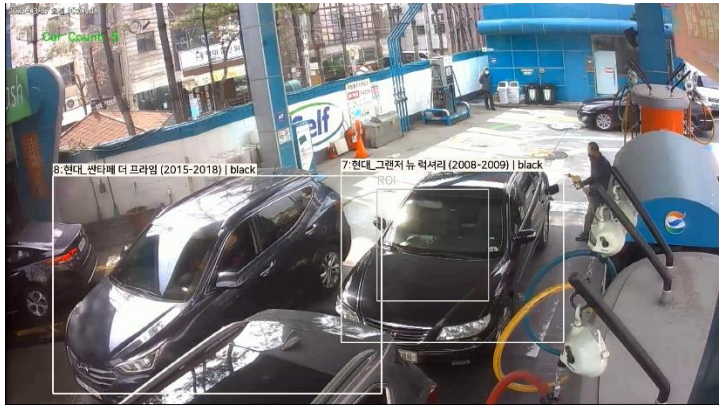
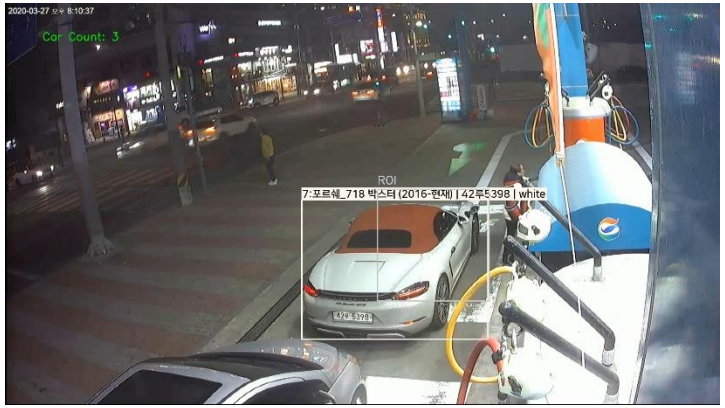
Motorbike and Helmet Recognition

+

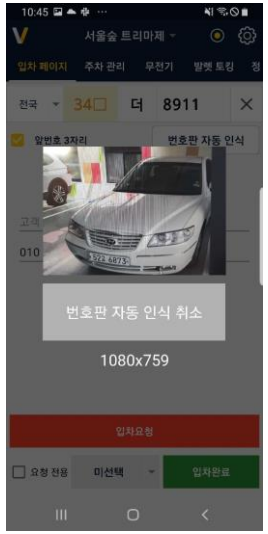


Lane Violating Vehicle Detection

4. Customers

Customers	Solution	Key Features
Korean Police Department (May 2021~)	**License Plate Recognition Service**	(1) Record videos while driving via front cameras of police cars (2) Real-time license plate recognition based on embedded PC 
GS Caltex (May 2020~)	**License Plate/ Vehicle Type Recognition and Statistics Service**	(1) License plate/vehicle type recognition based on gas station's CCTV footage (2) Files automated reports on statistics of recognized vehicles using gas station  

4. Customers

Customers	Solution	Key Features
㈜AJSellCar (May 2020~)	License Plate/Vehicle Type Recognition Service	(1) Provided vehicle recognition solution to one of the largest used car stores in Korea (2) Automatically recognizes license plate/vehicle type/manufactured year upon used car registration  기아 올 뉴 카니발 (14년~18년) 9인승 노블레스.jpg  기아 올 뉴 카니발 (14년~18년) 9인승 럭셔리.jpg  기아 올 뉴 카렌스 (13년~현재) 2.0 LPi 럭셔리.jpg
MyValet (May 2020~)	License Plate Recognition Service	(1) Cloud-based license plate recognition API service (2) License plate recognition in photos and videos taken freely using smart phones   

NEXTLab

Innovation with NEXTLab

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- **Nationally Accredited Certification (KOLAS) test report issued for vehicle license plate and vehicle model recognition accuracy**
  – (License plate recognition accuracy : 97.1% / Vehicle model recognition accuracy : 97.5 %)

Test Subject and Sample

- Select 1,000 cases of data(600 domestic cars, 400 imported cars) from used car websites where image files, license plates, and model information can be obtained at the same time
- Items registered within 4 days of the test date are eligible and invalid photos are excluded

Test Method

- Run an automated test script to run 1000 cases of test data and compare with pre-prepared Ground Truth information to generate Excel results table and verification images
- Calculate accuracy immediately with the result numbers on the Excel results table

Test Result

WISESTONE
서울 서초구 강남대로 273
송남빌딩 3층
(Tel:02-6257-5958, Fax:02-6257-5957)

성적서번호 : 202005-VSW-081-K
페이지(2)/총(8)

시험 결과 요약

번호	신청기관 제시 항목			ISO/IEC 25023:2016 측정 지표	
	시험 항목	시험 목표	결과	측정 지표	결과
1	차량 번호판 인식 정확도	차량 번호판 인식 정확도 95% 이상	기준 만족 (97.1%)	8.2.2 Functional suitability : Functional correctness : Functional correctness	0.971
2	차량 상세 모델 인식 정확도	차량 모델 그룹 및 상세 모델 인식 정확도가 각각 95% 이상	기준 만족 (차량 모델 그룹 인식 정확도 = 97.6%, 차량 상세 모델 인식 정확도 = 97.5%)	8.2.2 Functional suitability : Functional correctness : Functional correctness	0.975 (※ 차량 상세 모델 인식 정확도를 기능 정확성으로 측정함)

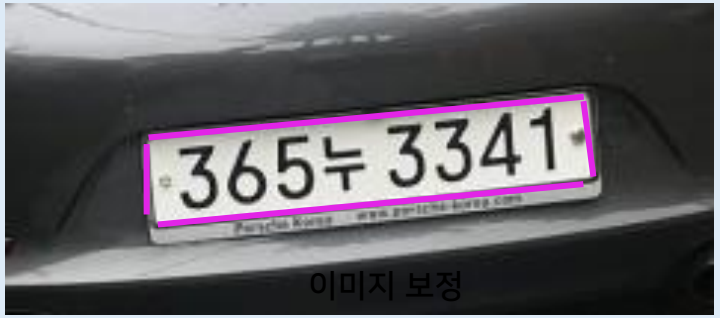
< Nationally Accredited KOLAS Test Report (2020.05.28) >

- AI-based license plate location and text recognition enables recognition of all license plates of Korean cars and motorcycles regardless of their type

Step 1: License Plate Location Recognition

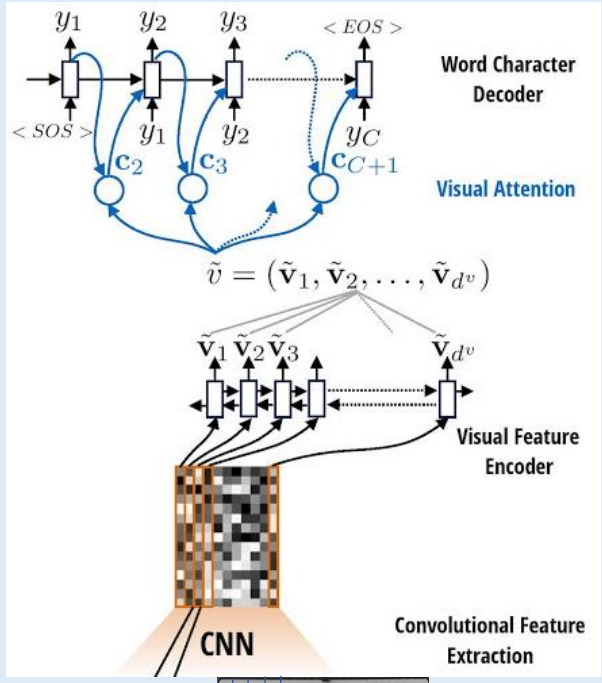
① Recognize license plate location from vehicle photos or videos

Step 2: License Plate Image Correction



② Correct the license plate image and standardize it to enable easy recognition

Step 3: License Plate Recognition



③ Recognize license plate texts with latest AI-based OCR algorithm

A. Annex – (2) Key Service Introduction – Vehicle Type Recognition

- The learning model for the front and rear images of the vehicle is separately managed to increase the recognition rate according to the photographing direction and angle

Step 1: Recognize Vehicle Frame → **Step 2: Recognize Photo Direction** → **Step 3: Recognize Vehicle Type/Model Year**

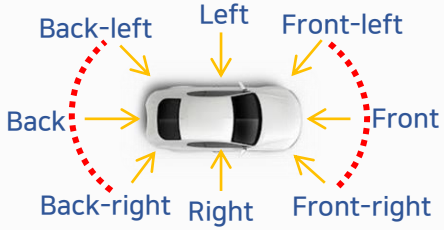
Front Direction

Vehicle Recognition Result

- Manufacturer: Hyundai
- Brand: Grandeur
- Model: Grandeur IG
- Year: 2016-2019
- Color: White

① Recognizes the vehicle frame and crops unnecessary background area

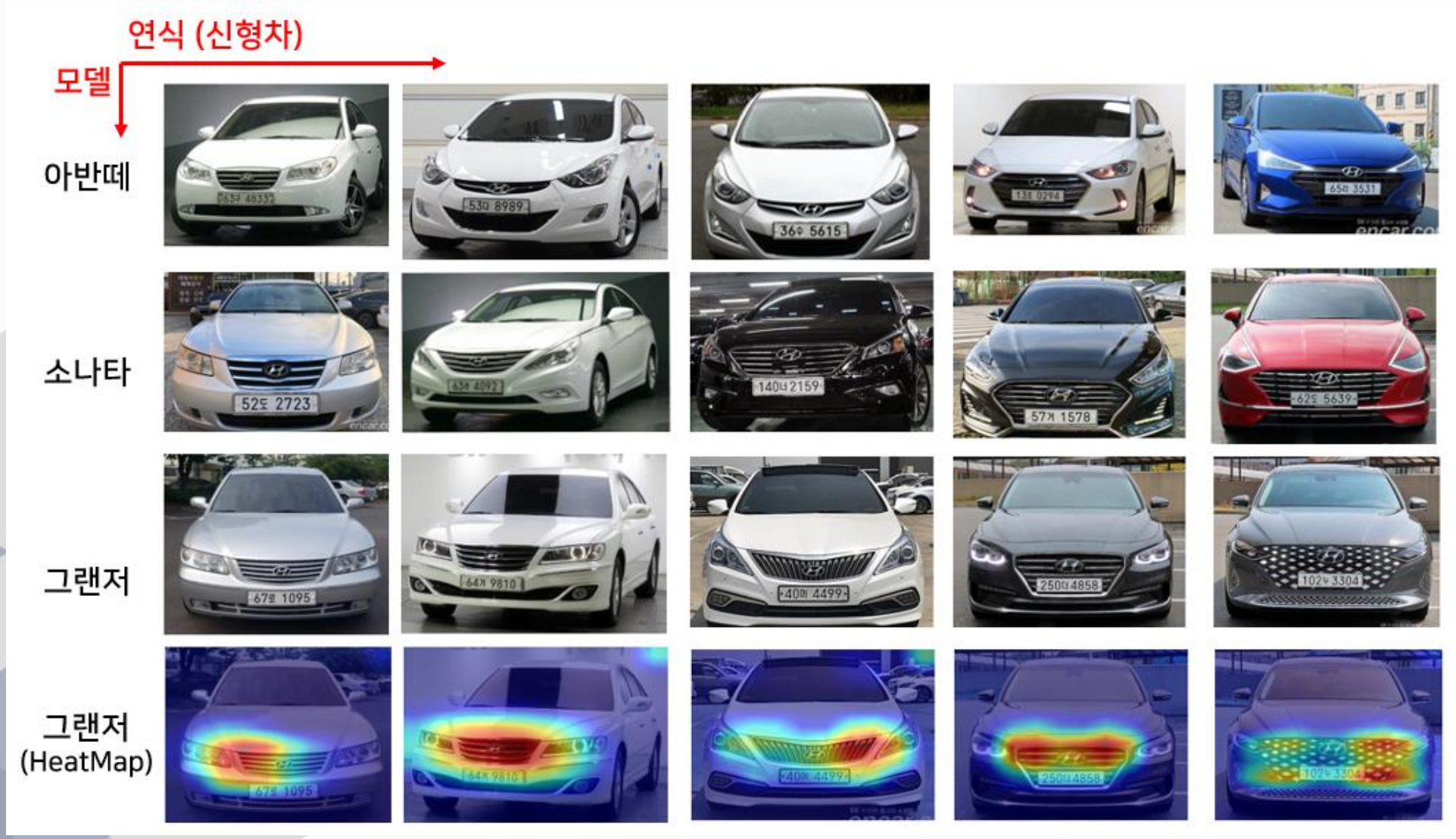
② Recognizes one of the eight directions below and selects the optimized learning model for vehicle recognition



③ Recognition results can be verified through the Heat Map below

A. Annex - (2) Key Service Introduction - Vehicle Type Recognition

- This service has market value in terms of expanding the categorizing of vehicle types by model(year)
- NEXTLab owns self-developed deep-learning algorithm and learning data used in this technology



A. Annex – (2) Key Service Introduction – Highway Monitoring with Drones

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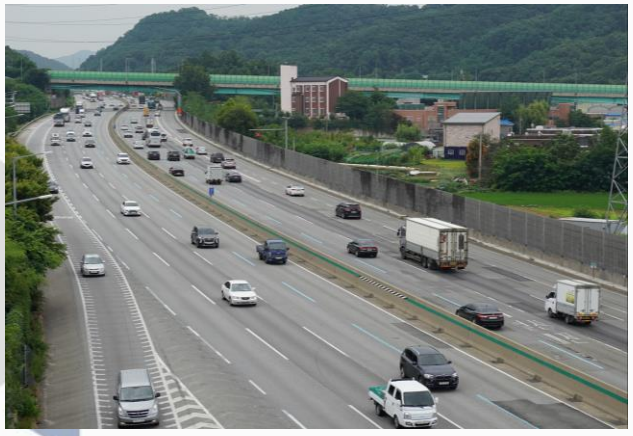
System that monitors traffic law violating vehicles by recording highway video footage with drones real-time and analyzing them with AI

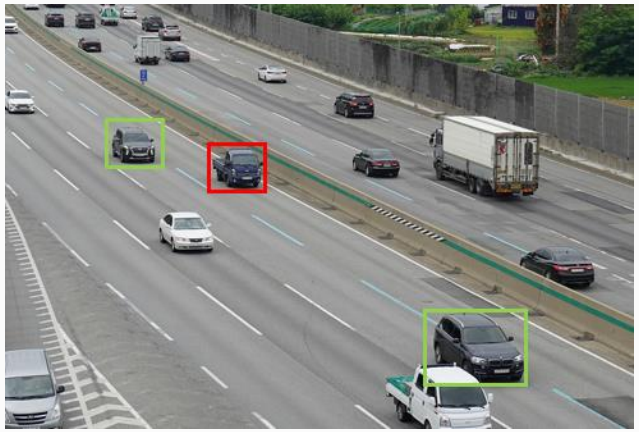
< AI-based Automated Drone Highway Monitoring Process

1. Clipping Drone Video Streaming



- Receives highway control video filmed by drone wirelessly and captures it in real-time

2. Automated Photographing of Traffic Law Violating Vehicles



- Sends filming signal so that drones can take high-resolution photos whenever they find traffic lane-violating vehicles via AI-based lane recognition and vehicle type recognition

3. File Automated Reports of Traffic Law Violating Vehicles

- Recognizes license plate based on high-resolution photos automatically filmed by drones
- Automatically produces report documents on traffic lane-violating freight vehicles that begin with license number 8 or 9

① Monitor highway vehicles

Highway Controlling Drones

②Real-time wireless video streaming

④ Drone control

1. Real-time Video Streaming: always transmitting
2. High-resolution Photo: Takes photos when there is a signal from the control center

⑤ Transmit high-resolution photos (out of sync)

Automated Report Processing Server

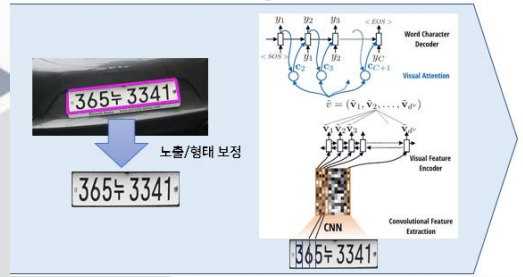
⑥ File automated reports on lane-violating vehicles

한국도로공사

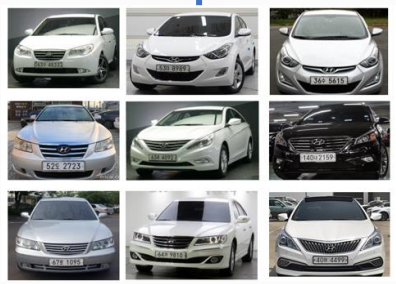
경찰 POLICE

Vehicle Base for AI Highway Monitoring

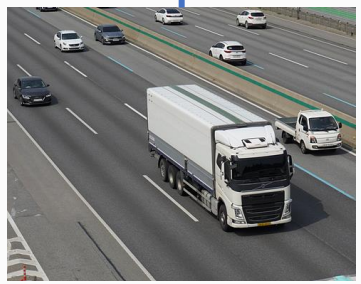
③ AI vehicle recognition module



License plate recognition module



Vehicle type recognition module



Lane recognition module

A. Annex – (2) Key Service Introduction – Exterior Damage Recognition

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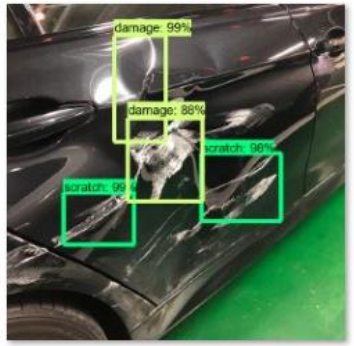
- Able to recognize various types(scratch / dent / broken) of vehicle exterior damaged area
- Recognition result can be verified through Heatmap

6.jpg

7.jpg

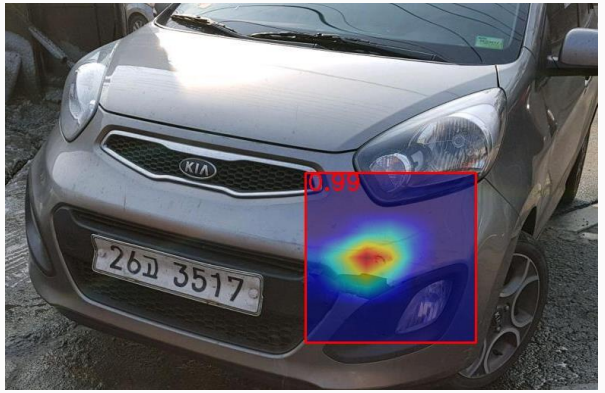

10.jpg

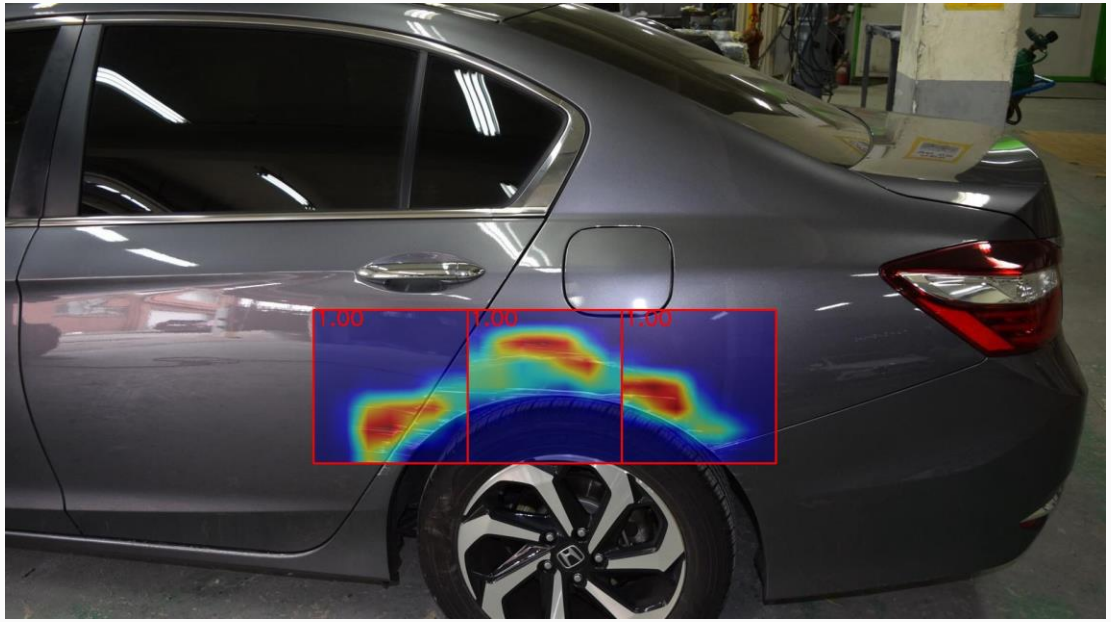


11.jpg


56.jpg

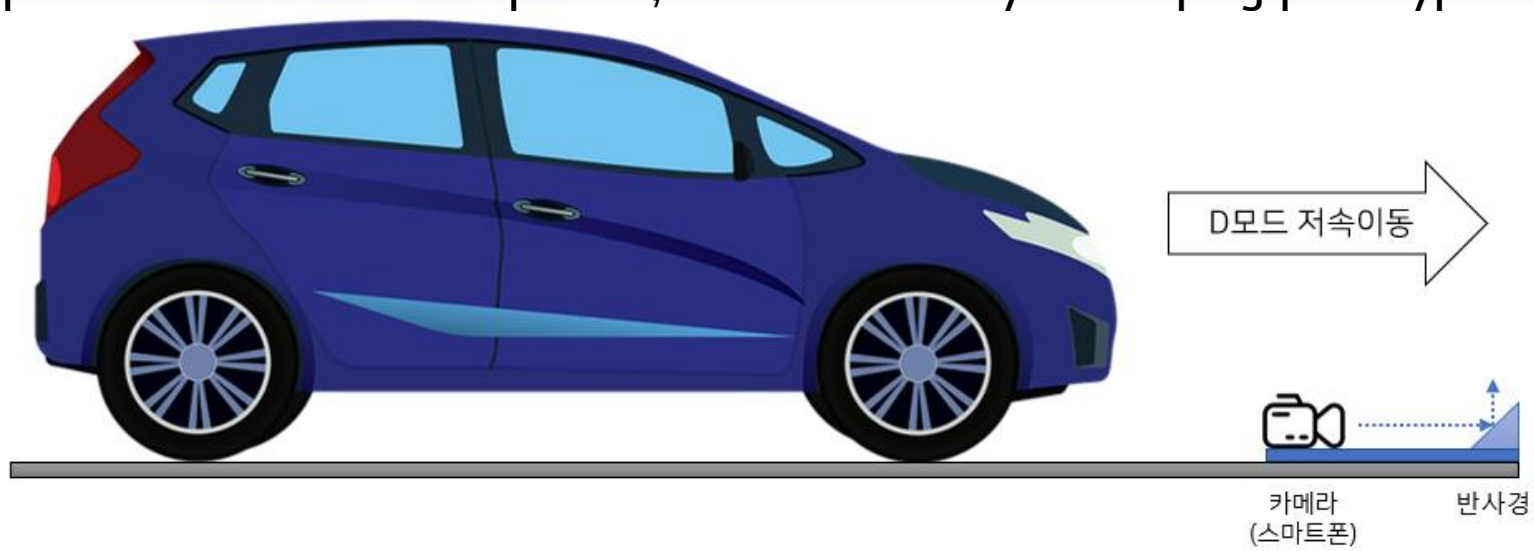
68.jpg





A. Annex – (2) Key Service Introduction – Vehicle Underpart Damage Recognition

- A portable under-vehicle photography solution that allows you to easily check the condition of the underside of the vehicle without equipment such as lifts in a repair shop
- After patent application[1] and POC completion, we are currently developing prototype



1) Patent application: Vehicle underside filming, video processing system and its methods (10-2020-0103309)