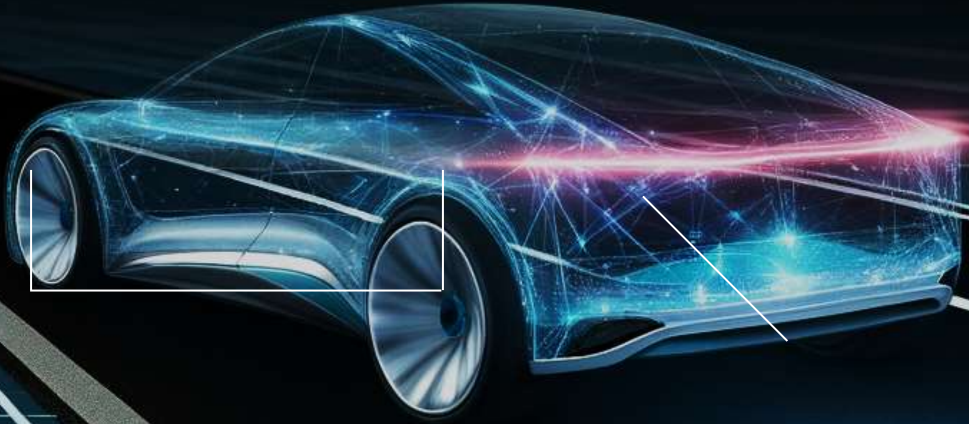
Introduction of Transport Vehicle Active Safety Solution



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Product Solution Introduction

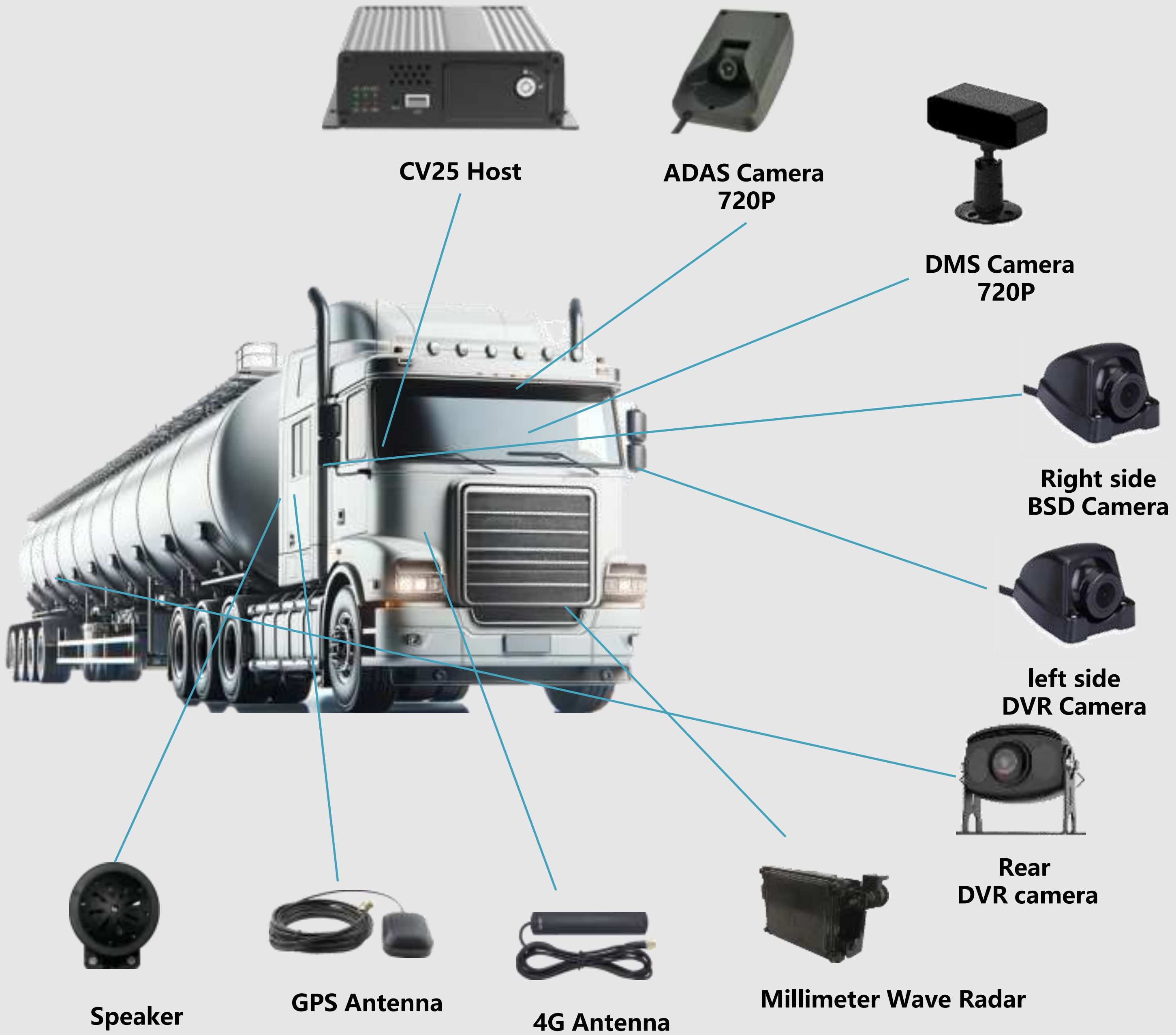
System Solution Overview

- The CV25 on-vehicle active safety solution is a comprehensive safety assistance and fleet management tool widely used in the commercial vehicle market. It monitors the driver and the vehicle's front and sides in real time, issues alerts, and uploads data to a cloud platform for enhanced safety management.

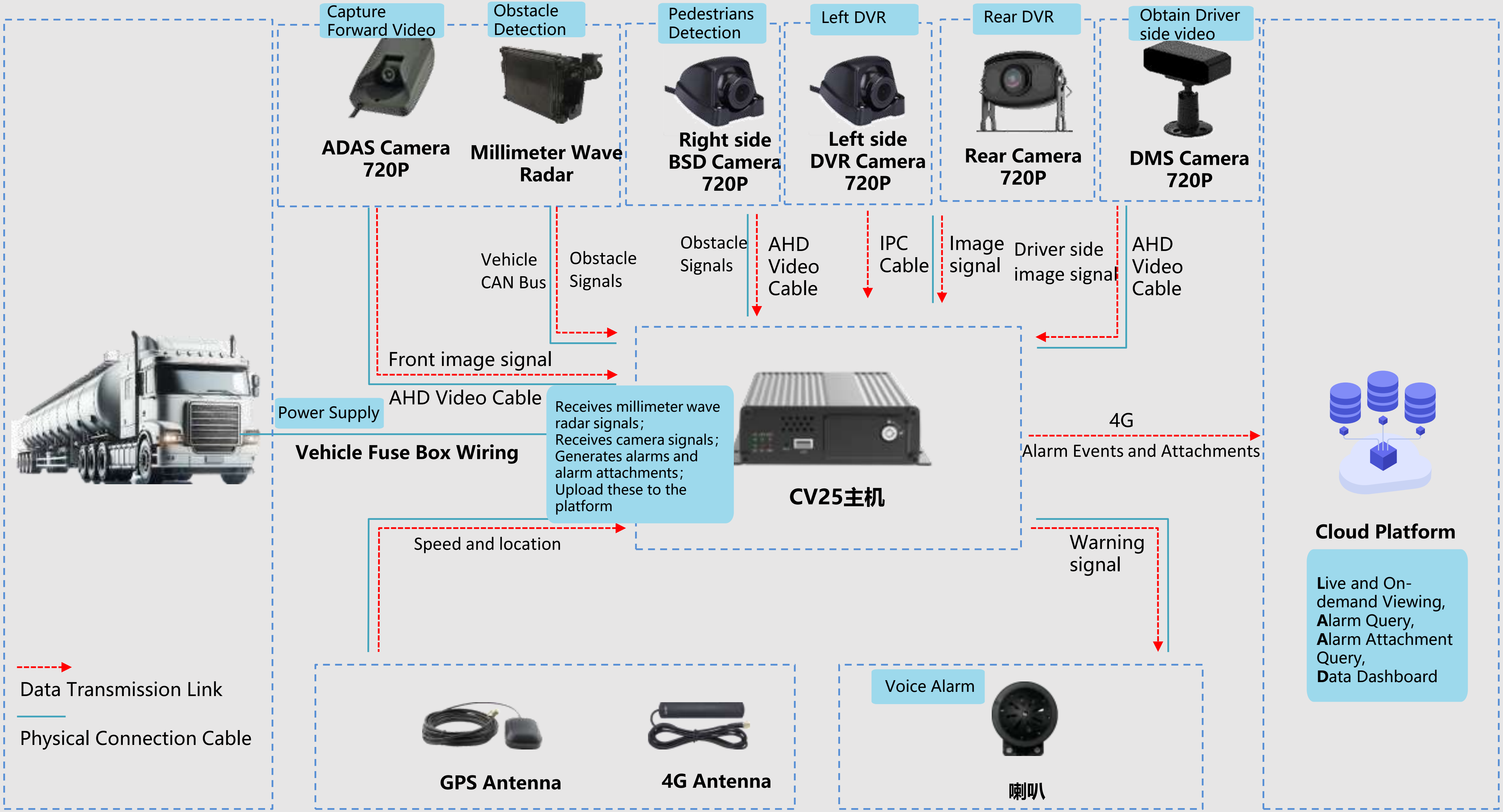
- Utilizing advanced AI chips and deep learning, the system detects blind spots around the vehicle, including the right A-pillar, rearview mirror, and inside wheel difference blind spots. It recognizes pedestrians and non-motorized vehicles within these areas and monitors the driver's condition to identify potentially dangerous behaviors such as fatigue, distraction, or phone use.

- When the system detects a hazard, it warns the driver through the vehicle's speakers, integrated with the vehicle's posture data. It records and stores 10 seconds of video surrounding an alarm event, using built-in 4G to upload this data to a supervisory platform for analysis, aiding in the investigation of safety incidents.

- The CV25 system features a modular design for ease of installation, comprising a main unit with GPS and 4G, DMS and ADAS cameras, a right blind spot camera, vehicle speakers, and a wiring harness. This streamlined structure simplifies the integration process into commercial vehicles.



System Solution: Vision + Millimeter Wave Radar



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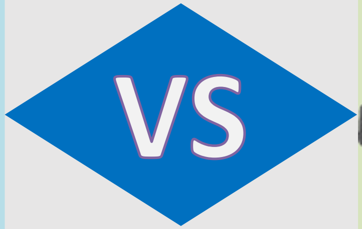
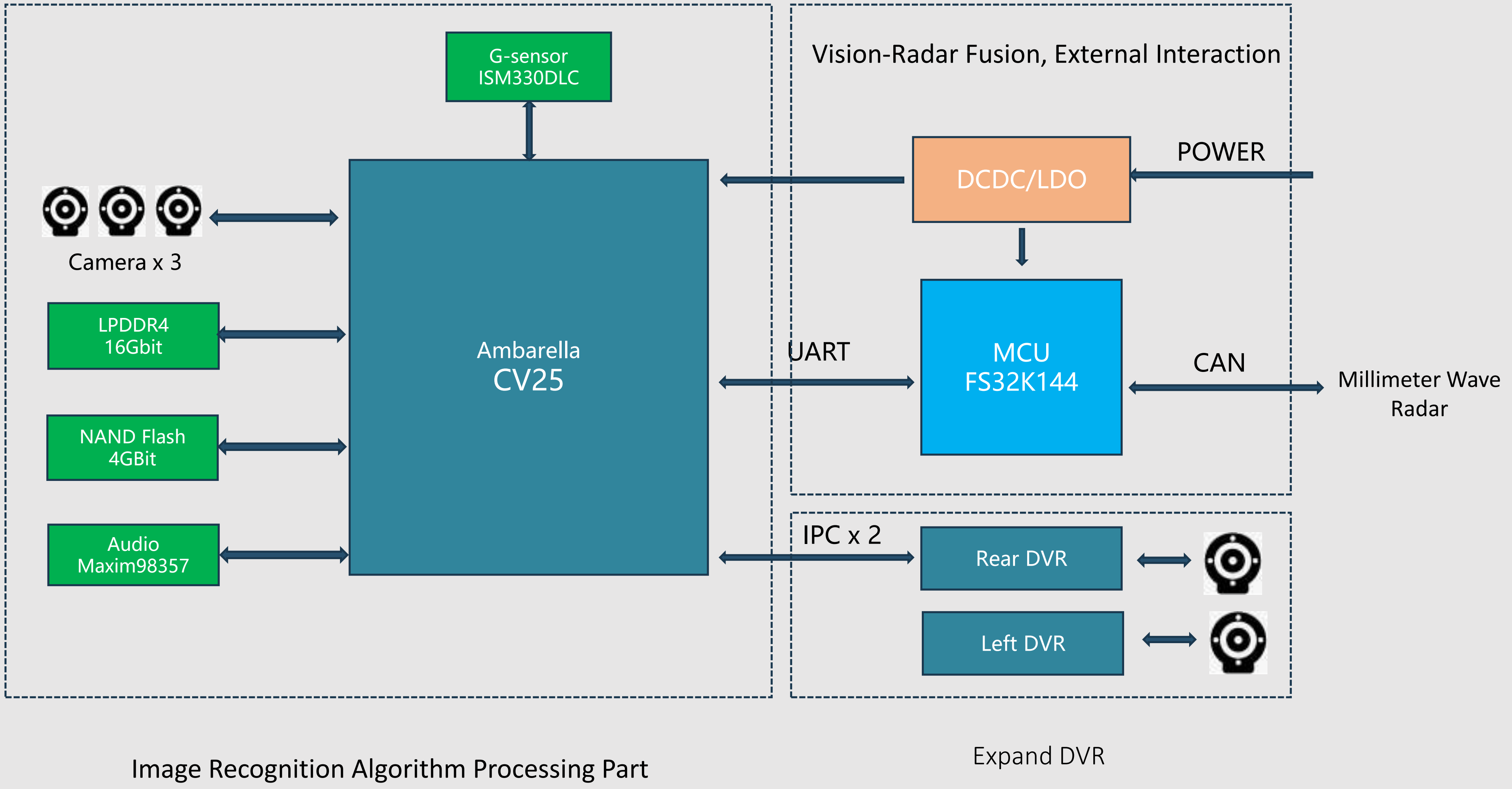


- The forward vision system includes an IMU unit, requiring only an additional millimeter wave radar for multi-sensor fusion and control decision output.
- A single vision processor accomplishes the fusion of vision and millimeter wave radar, reducing data link transmission, thus enhancing processing speed, real-time performance, and safety.
- High integration level, saving on the components for IMU and fusion ECU, reducing material costs.
- The product combination is straightforward, offering easier installation and calibration compared to other solutions, thereby saving on construction costs.

System Hardware Framework



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Visual Function and Performance Introduction

Vehicle Detection

Vehicle Detection Performance	
Target types	Sedans, buses, trucks, sanitation vehicles, etc.
Posture detection	Full angle recognition (frontal/side/partial)
Night detection	Support
Detection distance	170m
Overall Recognition Rate	99%
False Recognition Rate	0.50%
Distance Measurement Accuracy	<=5%

Nighttime

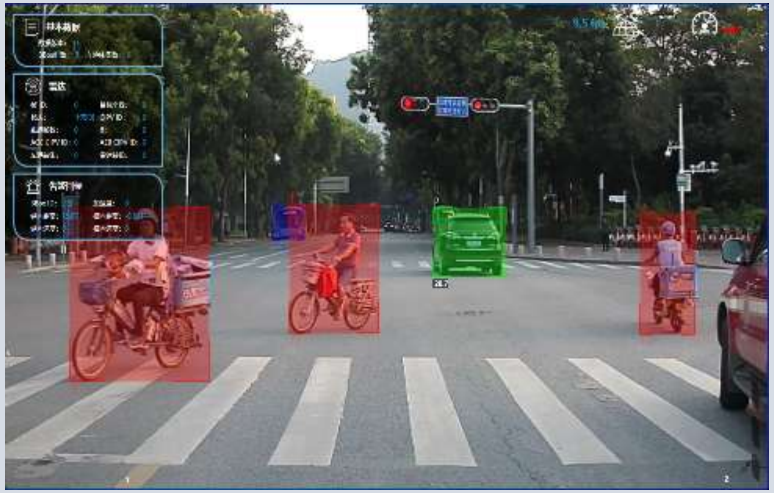
The side of buses

The side of buses

Uniquely shaped vehicles.

Pedestrian Detection

Pedestrian Detection Performance	
Target types	Includes bicycles, motorcycles, electric bikes, tricycles, pushcarts, etc.
Posture detection	Standing, squatting, lying down, etc.
Night detection	Support
Detection distance	70m
Overall Recognition Rate	98%
False Recognition Rate	1.00%
Distance Measurement Accuracy	<=10%



bicycles, motorcycles

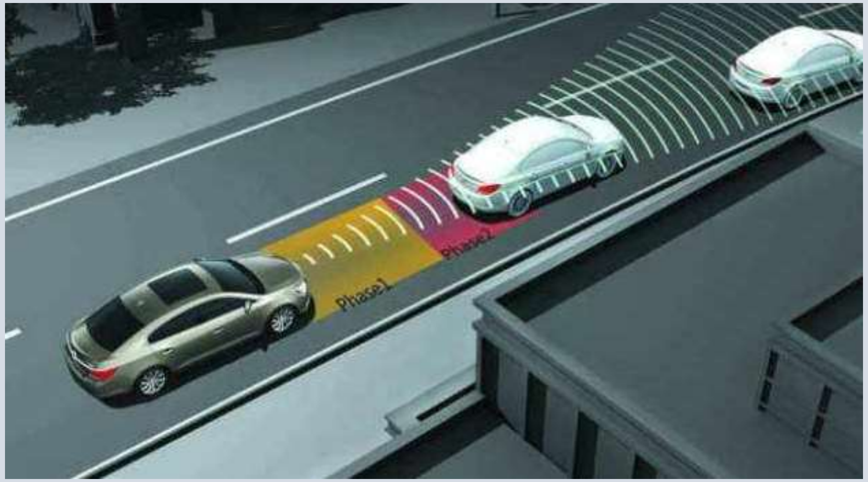
umbrella usage

distant groups of people

children, strollers

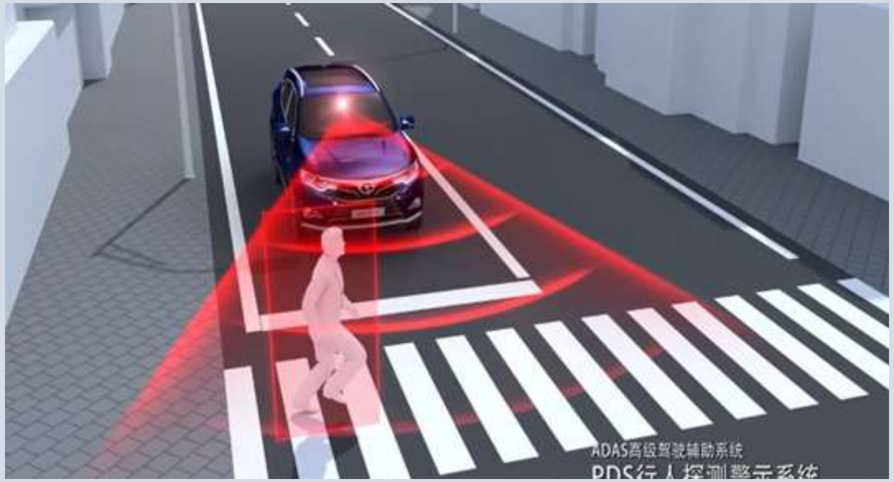
ADAS Functions

Forward Collision Warning (FCW)



- When the vehicle's speed is greater than or equal to 30km/h and there's a risk of rear-ending the vehicle in front, the collision warning function can alert the driver up to 2.7 seconds in advance. At speeds below 30km/h, if the distance to the vehicle in front is less than 1.2m, the driver will be warned, and corresponding alarm information and attachments will be uploaded to the platform.

Pedestrian Collision Warning (PCW)



- At vehicle speeds of 1-60km/h, the system continuously monitors a rectangular area 30m in front of the vehicle and 1.8m to either side for pedestrians. It calculates the Time to Collision (TTC) with any pedestrian in front. If the TTC drops to a dangerous level, indicating a collision with a pedestrian could occur within 2 seconds, the pedestrian collision warning system alerts the driver and uploads the relevant alarm information and attachments to the platform.

DMS Functions

Fatigue Driving
- Eye closure
- Yawn status
- Drowsy driving

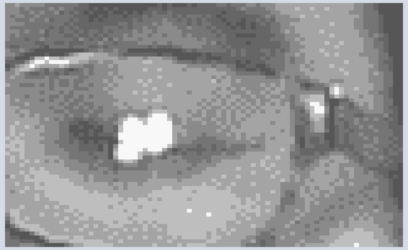
Attention Detection
- Eye tracking
- Head posture
- Distraction alarm

Behavior Detection
- Smoking
- On the phone
- Driver departure

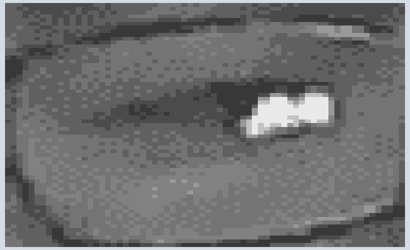
Device Detction
- Equipment occlusion
- Equipment failure
- Infrared sunglasses blocking

Bright/Shadowed face

Dark glasses, sunglasses



Eyeglass reflections

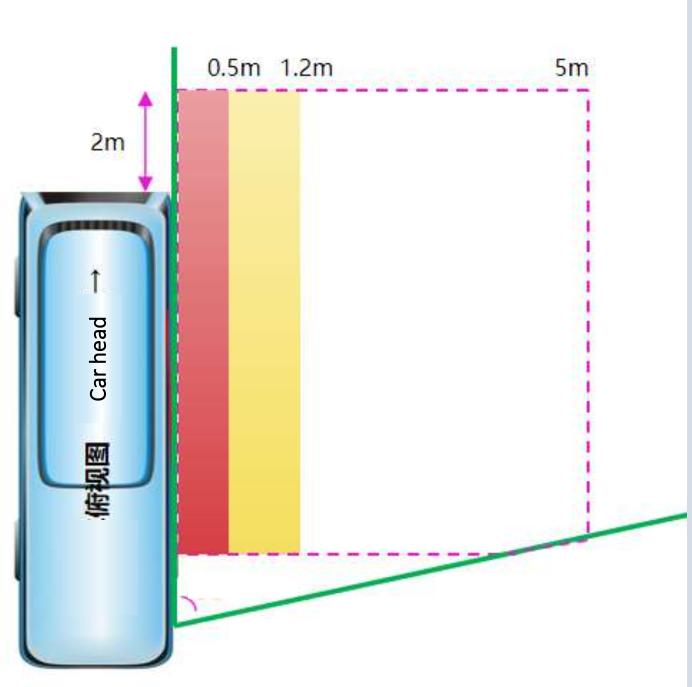


Dark-colored eyeglass frame

Applicable to various environments and light conditions.

- Intelligent adjustment of infrared light source scheme and supplementary algorithm, the best performance;
- High-performance camera and face optimization algorithm brings unified brightness;
- Complete function, stable algorithm, and reliable quality

Right side BSD Functions



A1 High-Risk Area: 0.5 meters beside the vehicle body (configurable), 2 meters in front of the vehicle

A2 Medium-Risk Area: 1.2 meters beside the vehicle body (configurable), 2 meters in front of the vehicle

Camera Field of View: Horizontal coverage angle of 102°, vertical coverage angle of 56°

Effective Alarm Targets: Pedestrians over 1 meter tall, cyclists, electric bike riders, motorcyclists, tricycle tracks; umbrella-holding, squatting, and other postures

Alarm Priority: High > Medium > Low

Alarm Target Filtering: Filters targets outside the shoulder, with a toggle option

Rear &Left DVR Functions

720P High-Definition View

Wide-Angle Lens Multi-Lane Shooting Local Loop Recording

Local Loop Recording

Collision Lock Video

Starlight Night Vision Infrared Supported

Day time

Night time

Visual Part Specifications

Category	Description
Main chip	Ambarella CV25
MCU	FS32K144
Camera	Resolution: 1280*720, Pixel Pitch: 3.75um, SNR: 43.9dB, Dynamic Range: 115dB,Horizontal Field: 40°, Vertical Field: 30°
Dimensions	131mm*79mm*42.3mm
Weight	371g
Operating Voltage	9--36V
Power Consumption	4W（Typ.） 5W（Peak）
Standby Current	460uA
Main Materials	ABS,ADC-12
Operating Temperature	-20--70℃
Storage Temperature	-40--85℃
Operating Humidity	≤90%
Video Output	NTSC/PAL
External Interface	Micro USB * 1、CAN * 1
Target Detection Frame Rate	20FPS

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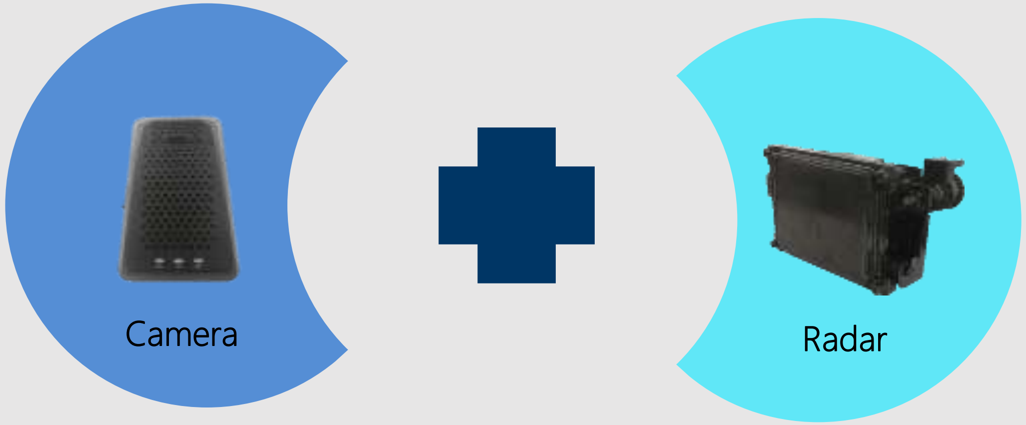
Fusion Algorithm Introduction

Visual vs. Radar Advantages and Disadvantages Comparison



- Distance measurement (short range)
- Target location
- Height and width detection
- Quantity detection
- Target recognition and classification
- Pedestrian recognition and detection
- Lane line recognition

- Distance measurement (long range)
- Speed measurement
- Target location
- Target quantity detection
- All-weather detection
- …

Visual: Can recognize lane lines, perform target classification;
Radar: High accuracy in distance and speed measurement, supports all-weather operations.

Visual and Radar Target-Level Fusion

Typical fusion methods include:

- **Raw Data Fusion:** Direct fusion of raw data from sensors at the central processor for real-time integration. Offers high precision and flexibility but requires powerful processors and is less reliable due to large data volumes.

- **Target-Level Fusion:** Local processing of raw data from independent sensors first, then the results are sent to the information fusion center for intelligent optimization. This method demands less communication bandwidth, has faster computation speed, reliable and sustainable, but with less accuracy than centralized processing.

Two typical target-level fusion methods:

1.Based on the relationship of positions in the world coordinate system, relying on strict sensor calibration.

2.Based on trajectory fusion, identifying targets with similar positions and motion trends for fusion.

To enhance fusion accuracy, combining both methods:

1.Refers to sensor calibration results without strict dependence on the world coordinate system's positions;

2.Tracks target trajectories, where occasional missed detections of stable targets do not affect continuous tracking.

Visual and Radar - Slopes Issue

On slopes, the spatial angle between the target and the radar vehicle is significant, causing radar target points to deviate from the correct target when mapped to the image coordinate system.

To address this, the vertical angle between the bbox target and the radar vehicle during slope calculations is considered. The calculated angle is used to correct the radar target coordinates before remapping to the image coordinate system, ensuring accurate placement of the radar target points at the center of the target vehicle, providing a precise basis for integrating and matching visual bbox and radar points.

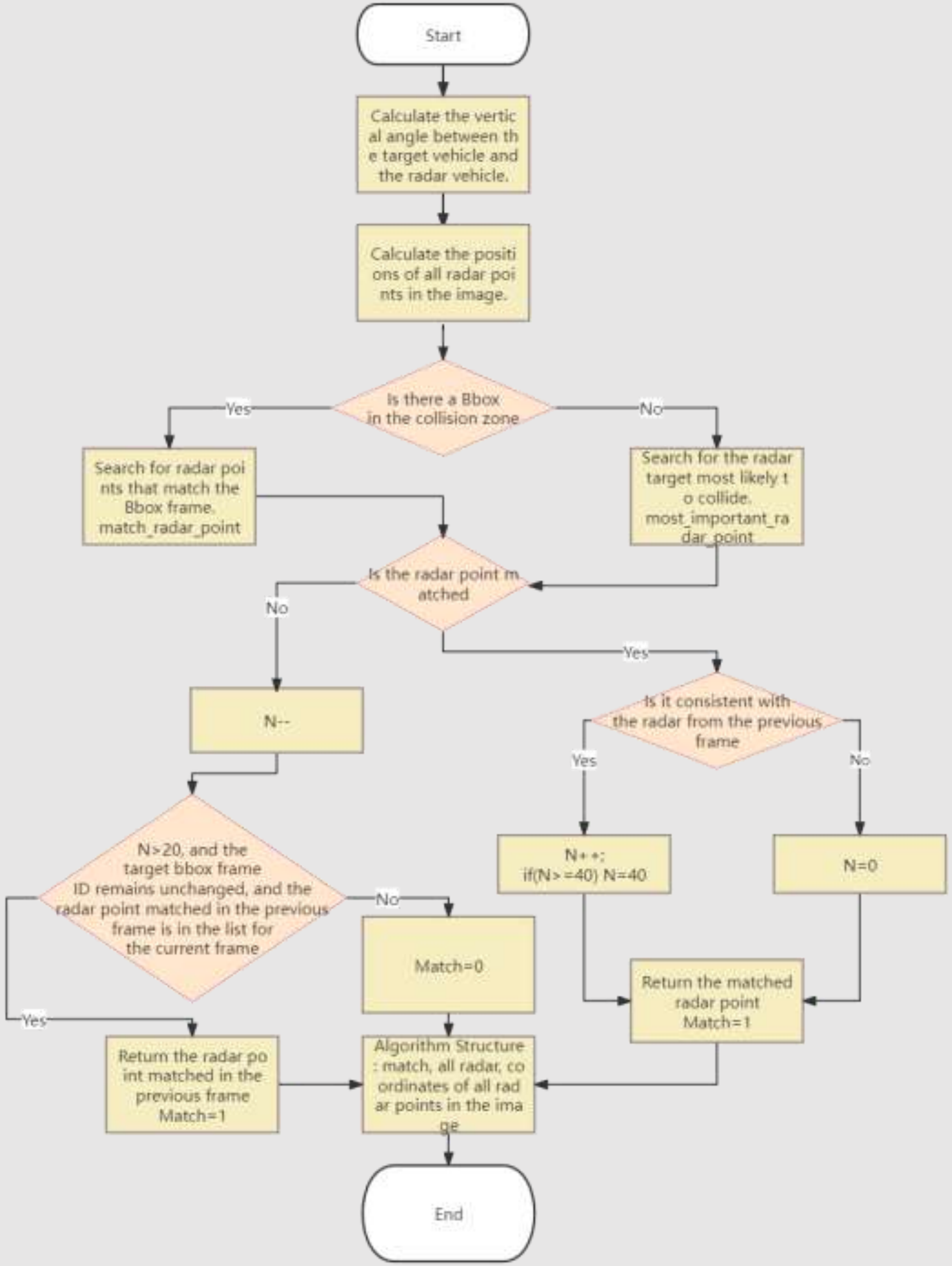
Fusion Algorithm Introduction

Fusion Process

1. Joint calibration of the camera and radar to unify the coordinate system.
2. Calculate the angle between the target and the vehicle.
3. Associate image targets with radar targets.
4. Select targets with high association for fusion.
5. Track stable targets and maintain tracking.
6. Output tracking results.

Core Algorithms

1. Correct the angle between the target and the vehicle.
2. Association table for image targets and radar targets.
3. Trajectory tracking.



Fusion Effect Display

Display of vision and radar results in a top-down view.

Vision semantic segmentation information.

Targets not successfully fused.

Successfully fused targets.

Vision-detected target information.

Radar-detected target information.

4

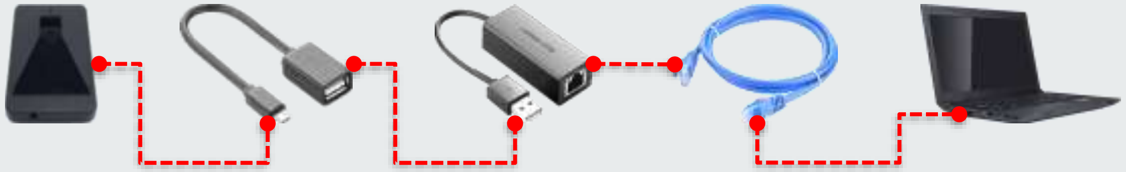
Installation & Testing

Vision Installation and Debugging

Installation

1. Install the device at the lower edge of the windshield in the middle, ensuring the camera is not obstructed by the wipers.
2. Use the device's 3M adhesive for attachment.
3. Complete wiring and connection according to the vehicle model.

Debugging Wiring



IP Configuration

Configure the IP to 192.168.198.199 for the network connection identified as "Realtek USB GBe Family Controller."

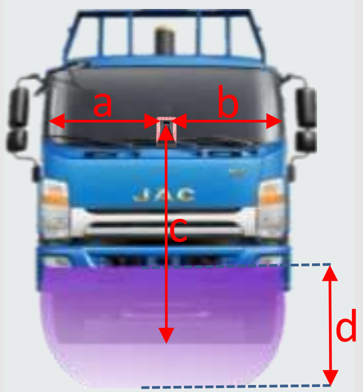
Prototype Calibration

1. Open the calibration software on the computer and enter the calibration interface.
2. Enter the suggested value "350" for the horizon line and adjust the camera angle so the horizon appears within the indicated red frame.
3. Measure the corresponding data as shown on the right, enter it into the respective fields, and click to calibrate.

Batch Calibration

1. Pre-installation can ensure ADAS vision device installation consistency through tooling.
2. Calibrate a prototype vehicle for one model, measure a set of data, and batch install vehicles by directly importing the calibration file for calibration.

Data to be measured



a: Distance from the camera to the vehicle's right edge
b: Distance from the camera to the vehicle's left edge
c: Camera installation height
d: Distance of the vision blind spot

Tips

- Pure vision installation takes about 10~15 minutes.
- Prototype calibration takes about 2 minutes.
- Batch calibration takes about 30 seconds.

Product Testing

ADAS has passed JT/T 883, JT T1242-2019 testing and certification.

Functionality tests

- GBT and JT/T related testing standards
- ISO/NHTSA related standards
- NCAP standards, etc.

reliability tests

- Environmental tests
- electrical characteristics tests
- physical tests
- aging tests

environmental and chemical tests

- RoHS detection
- volatile organic compound detection, etc

electromagnetic compatibility tests

- Electromagnetic radiation immunity tests,
- ESD electrostatic discharge tests, etc

Product Test reports

JT/T-883 LDW Inspection Report

JT/T-883 FCW Inspection Report

Thank You