Urban Commute HandBook

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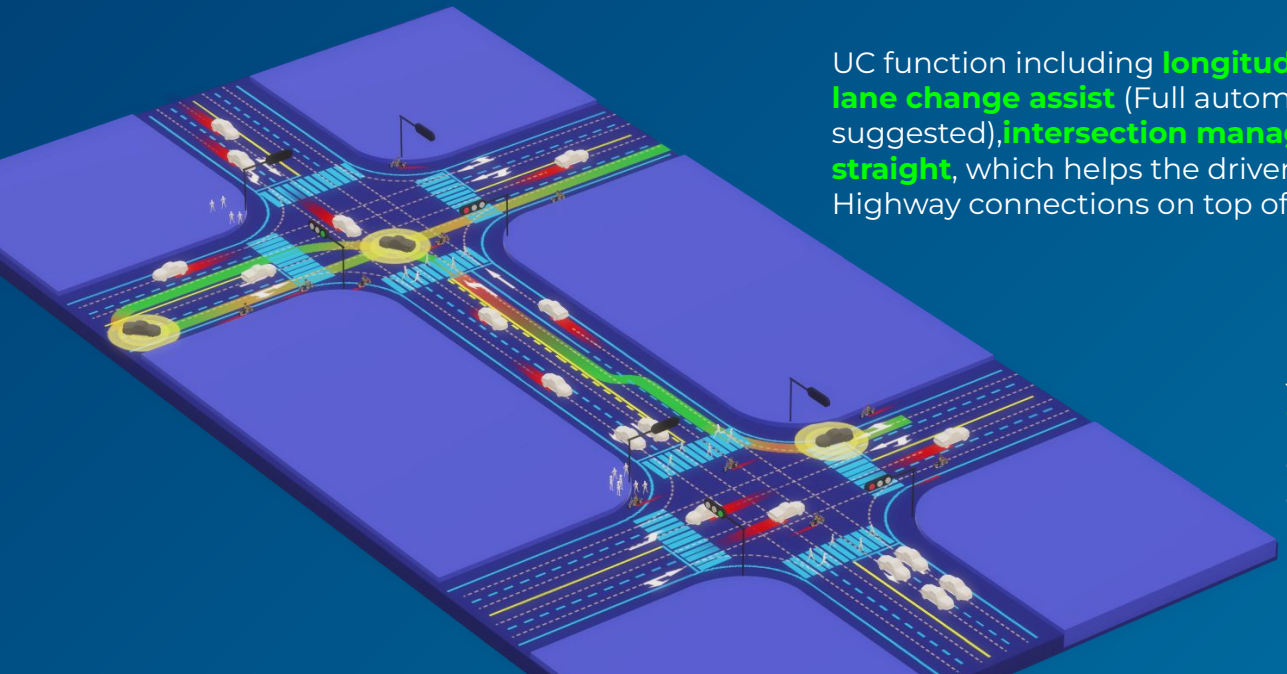
SMART TECHNOLOGY FOR SMARTER MOBILITY

FUNCTION INTRODUCTION

General introduction

UC(Urban Commute) is an integrated **L2+** function which could provide Automated Driving Assist Under driver's supervision **(Hands On + Eyes On)** within in **urban and structural road** environment from **point A** and **point B** (start point and destination defined by user's learning results) after manually driven the route and the system been successfully memorized the route supporting upto **100 KM**. In the cruising phase, the function work's under the speed range **[0,60]** kph



UC function including **longitudinal, lateral control** of the vehicle, and **lane change assist** (Full automatic, driver triggered and system suggested),**intersection management** including **left/right turn and go straight**, which helps the driver to perform Automatic overtaking, Highway connections on top of the HWA functions today.

During the Cruising phase, the control of the vehicle will try to respect the **driver's initiative behavior** but still based on the available **environment input**, **traffic rules** and **travel efficiency**.

FUNCTION INTRODUCTION

ODD Definition

- Operation speed:
  - Learning phase: [0 - 60] kph
  - Cruising phase: [0 - 60] kph in urban, [0 - 130] kph in closed road
- GeoFence:
  - ODD is defined to be in urban scenarios at least road level 2
  - Intersections and roundabout is supported
- Driver Status:
  - Hand on & eyes on
- Maneuver limit
  - U-turn is not supported
  - Drive backwards is supported during the learning phase
  - Drive backwards is not supported during the cruising phase
- Target obstacles
  - Traffic Participant
  - VRUs
  - General Object
  - Road Condition
  - ...

The detail subtype and description can be find in the document

FUNCTION INTRODUCTION

Key Performance Indicators

- Memorizing Performance:
  - Target single Route length is 100 KM ~ 150 KM (100 KM as a MUST, 150 KM as our target).
  - The system shall keep the learning success rate > 90 %

- Cruising Performance
  - The system shall correctly pass the intersection in the Route, successful rate > 90%
  - The system shall keep the take over rate under 1 / 100 KM
  - The system shall create 0 accident with target within the ODD
  - The system shall violate 0 traffic rules

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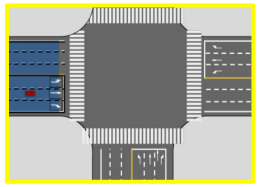
FUNCTION INTRODUCTION

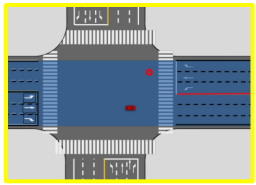
Feature List

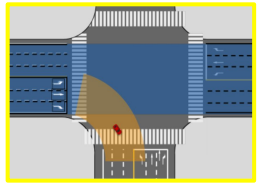
Feature	Sub-Feature
In Lane Longi Control	Cruising Control
	Vehicle Follow Control
	ACC S&G
	Speed Management
	Pedestrian Managing
	Static Object Strategy
In Lane Lateral Control	Lane Centering Control
	Human/Machine Co-driving
	Nudge (static object) - dynamic to be the target
Lane change control	Driver Triggered lane change
	Automatic overtaking
	Evasive lane change
	Navigation lane change
	Lane merging avoidance
	Lane Change Safety maneuver
Intersection Management	Intersection S&G
	Waiting zone management
	Straight through intersection
	Left turn through intersection
	Right turn through intersection
	Non-standard intersection
	RoundAbout Management
Target avoidance	In lane avoidance
	Omnibus avoidance
	Dynamic target avoidance
	Toll-both passing
Route Memory	First routing memory
	Memorized Routing Enhancement
Route planning	

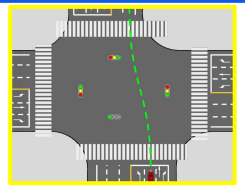
FUNCTION INTRODUCTION

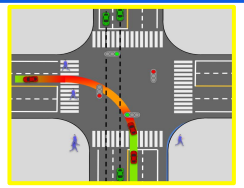
Use Cases

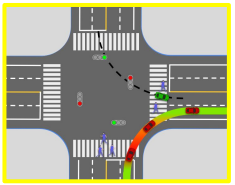

Start New Route

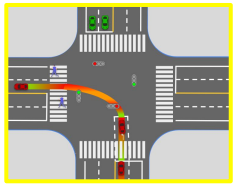

Element Update

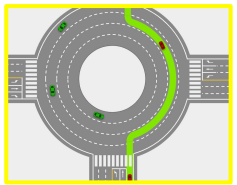

Route Update

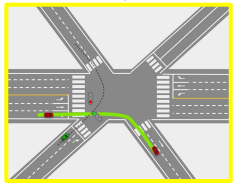

Straight through

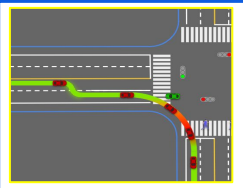

Unprotected Left Turn

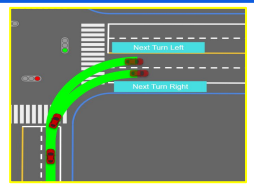

Right Turn


Waiting zone

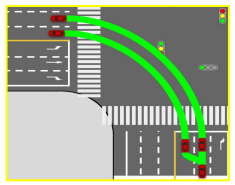

RoundAbout

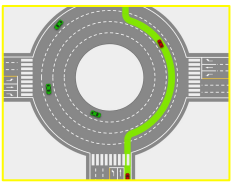

Complex Intersection

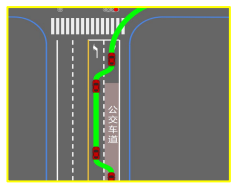

Lane Change Planning

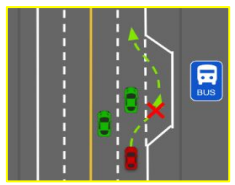


Intersection Lane Choice


Drivable lanes selection


Route Plan in Roundabout


Traffic Rules



Overtaking inhibition

- *Use Case - Learning*
- *Intersection Management*
- *Route Planning*

FUNCTION INTRODUCTION

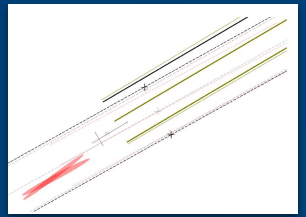
General Introduction

Memorizing

Driver taking the control the vehicle and driving through the navigation route, ADAS system will perceive the environment and create a local map for the next usage

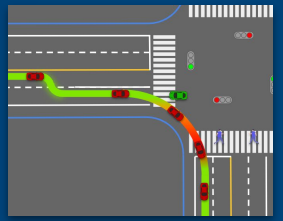
Localizing

When the vehicle drives into the area where system has been learned before. The system will use multiple input, local map, camera input, radar input and GNSS input to localize the vehicle in the map to be able get information for controlling



Cruising

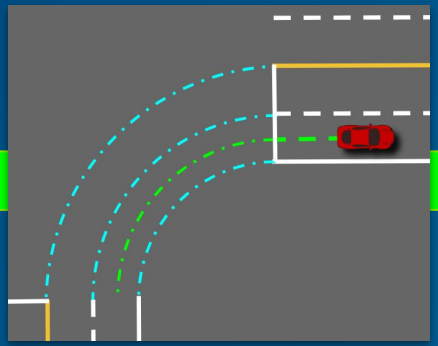
After the vehicle is localized within the local map, with the input of the map, onboard sensor information, real time navigation input, GNSS and IMU input. The system controls the vehicle cruising through the memorized route.



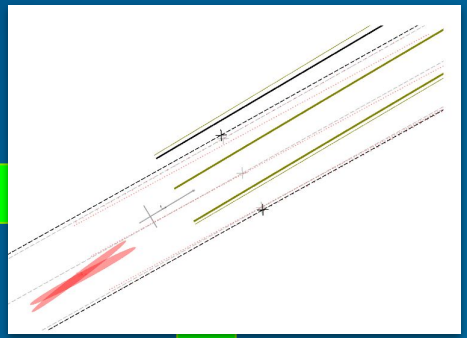
FUNCTION INTRODUCTION

Overall Introduction

Using VSLAM technology to build up local vector Map recording necessary element for localization and driving guidance as well as the driving trajectory (which lane is taken)

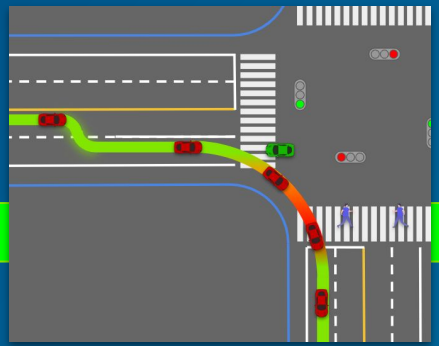


With help of high precision IMU and vehicle dynamic motion algorithm, create virtual lane marker and driving guidance line specially in intersection scenarios

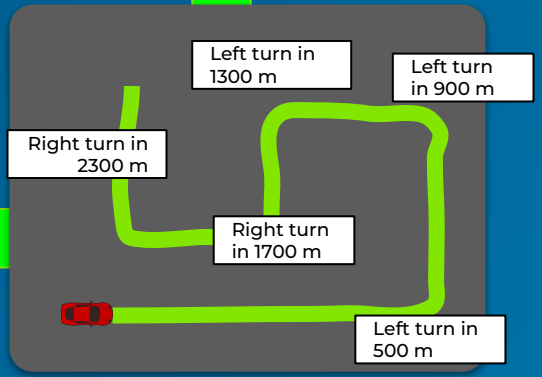


Using two layer localization: GNSS localization and sensor/map fusion localization to precisely locate the vehicle in the virtual environment model

By memorizing the driving behavior along the trajectory (speed, braking force...) and applying this to the vehicle control to manage the whole expericces



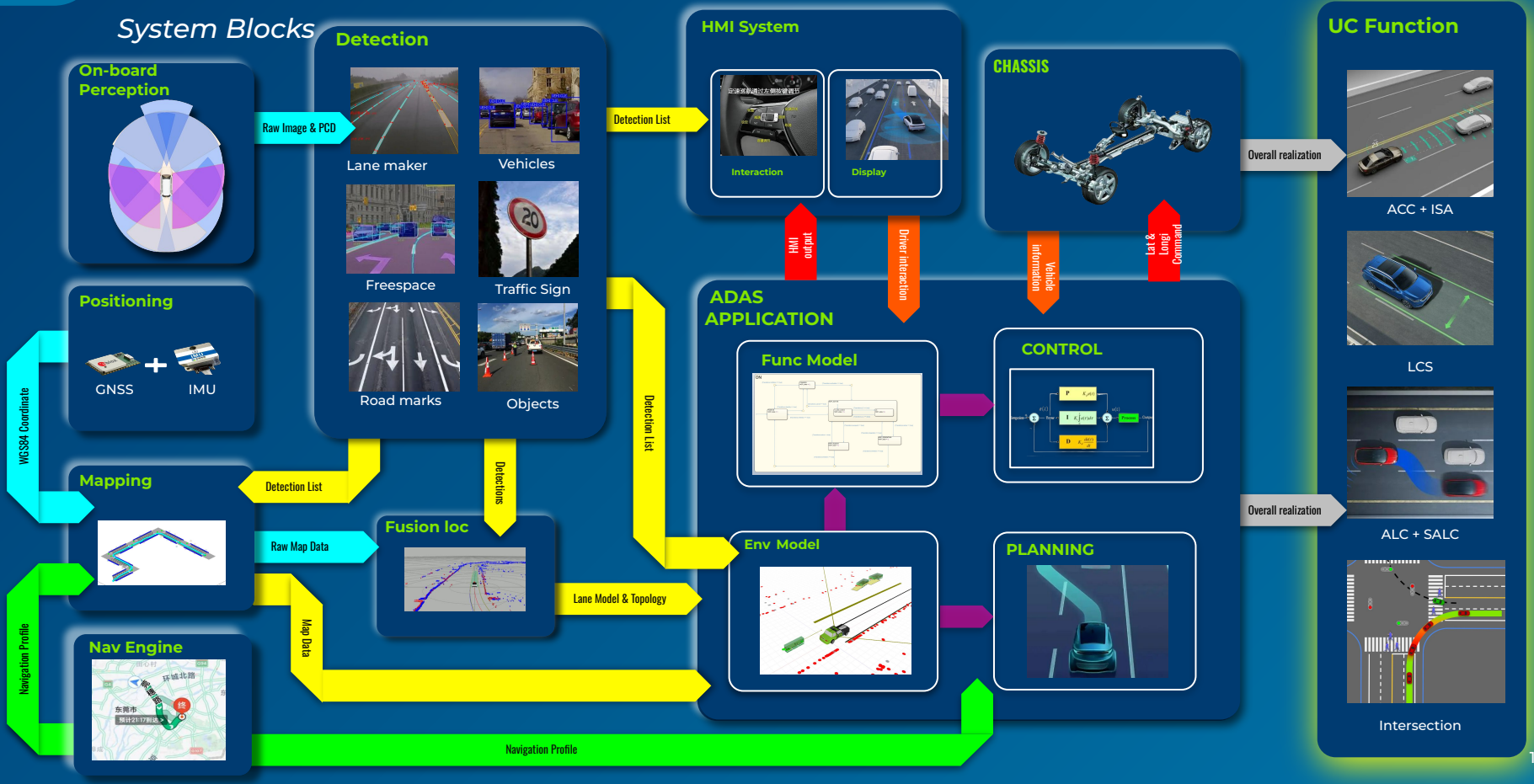
Combining the road level routing indication and the lane level road topology, ADAS system could calculate the correct lane level routing information



From the base of memorized road, ADAS system could calculated road level trajectory indication eg: to take a left turn in 500 m.

FUNCTION INTRODUCTION

System Blocks



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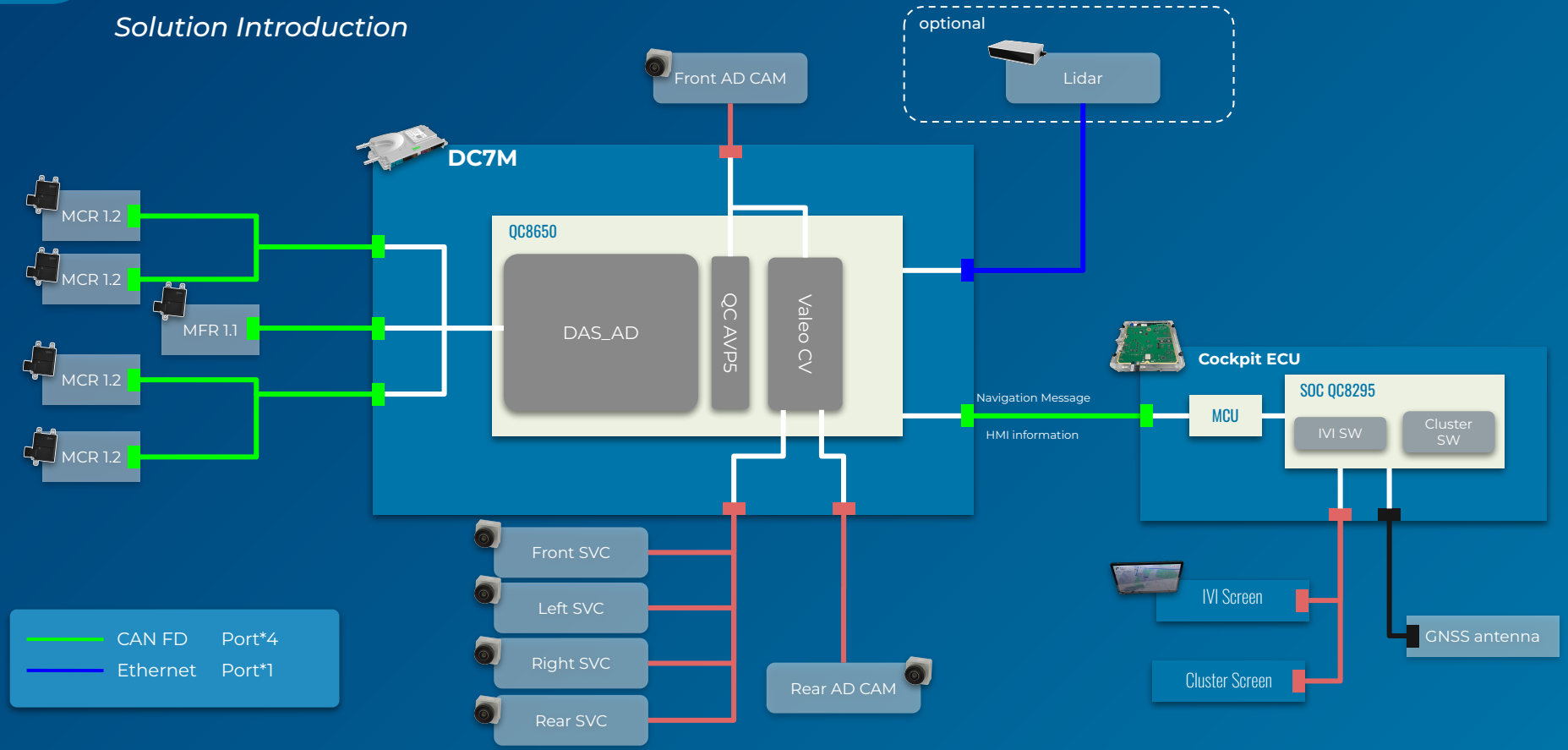
FUNCTION INTRODUCTION

Solution Introduction



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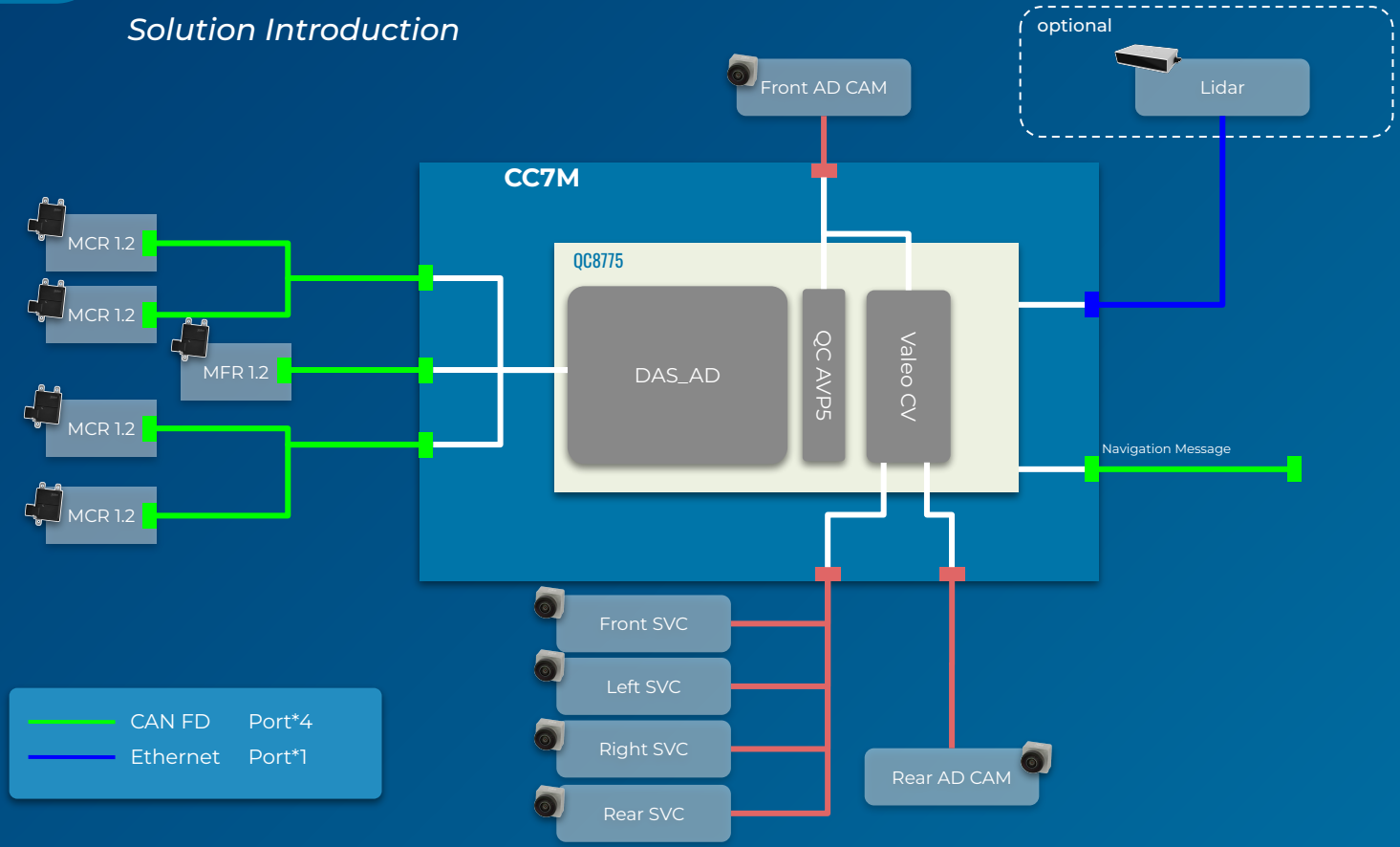
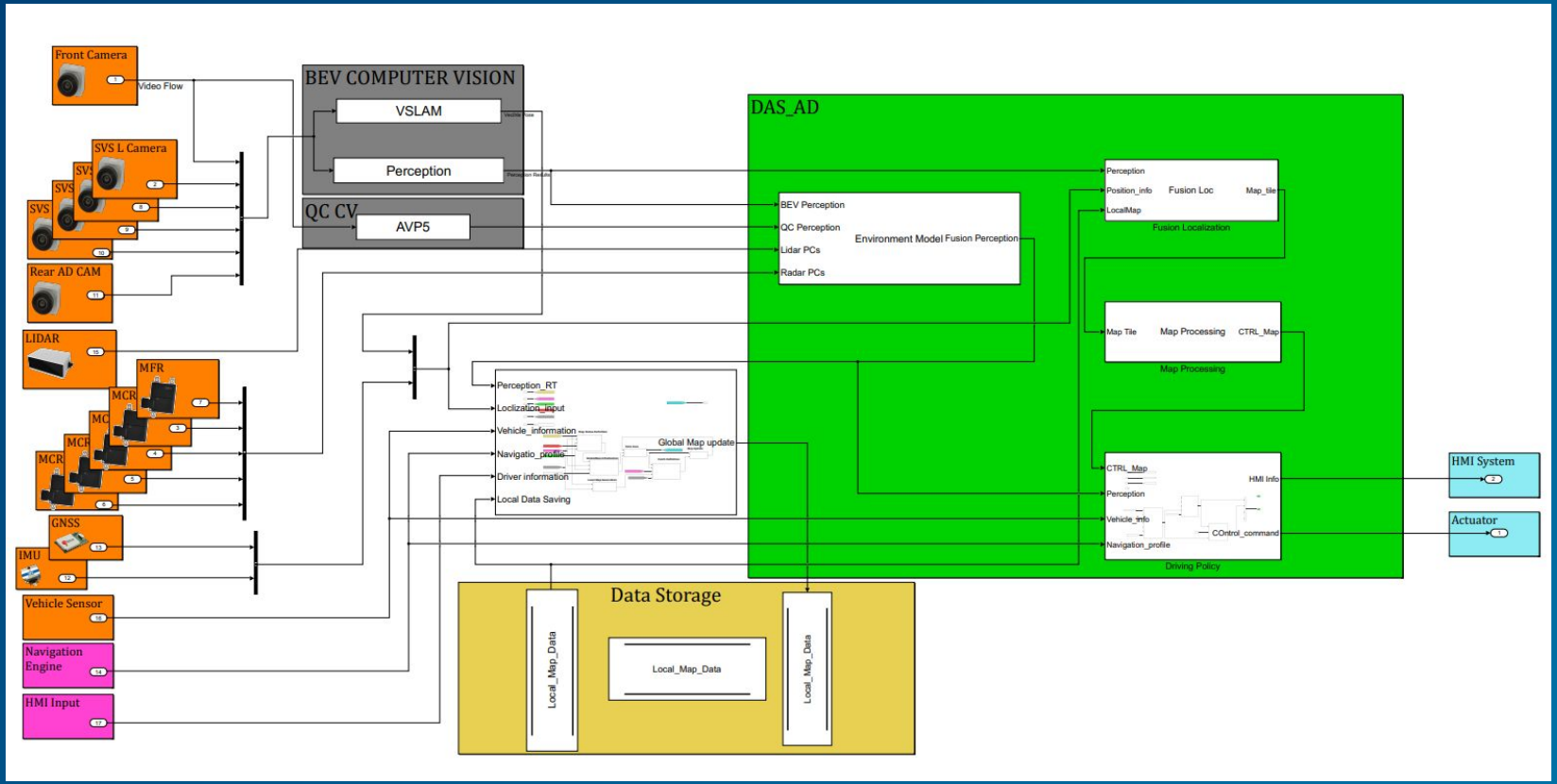
FUNCTION INTRODUCTION

Solution Introduction



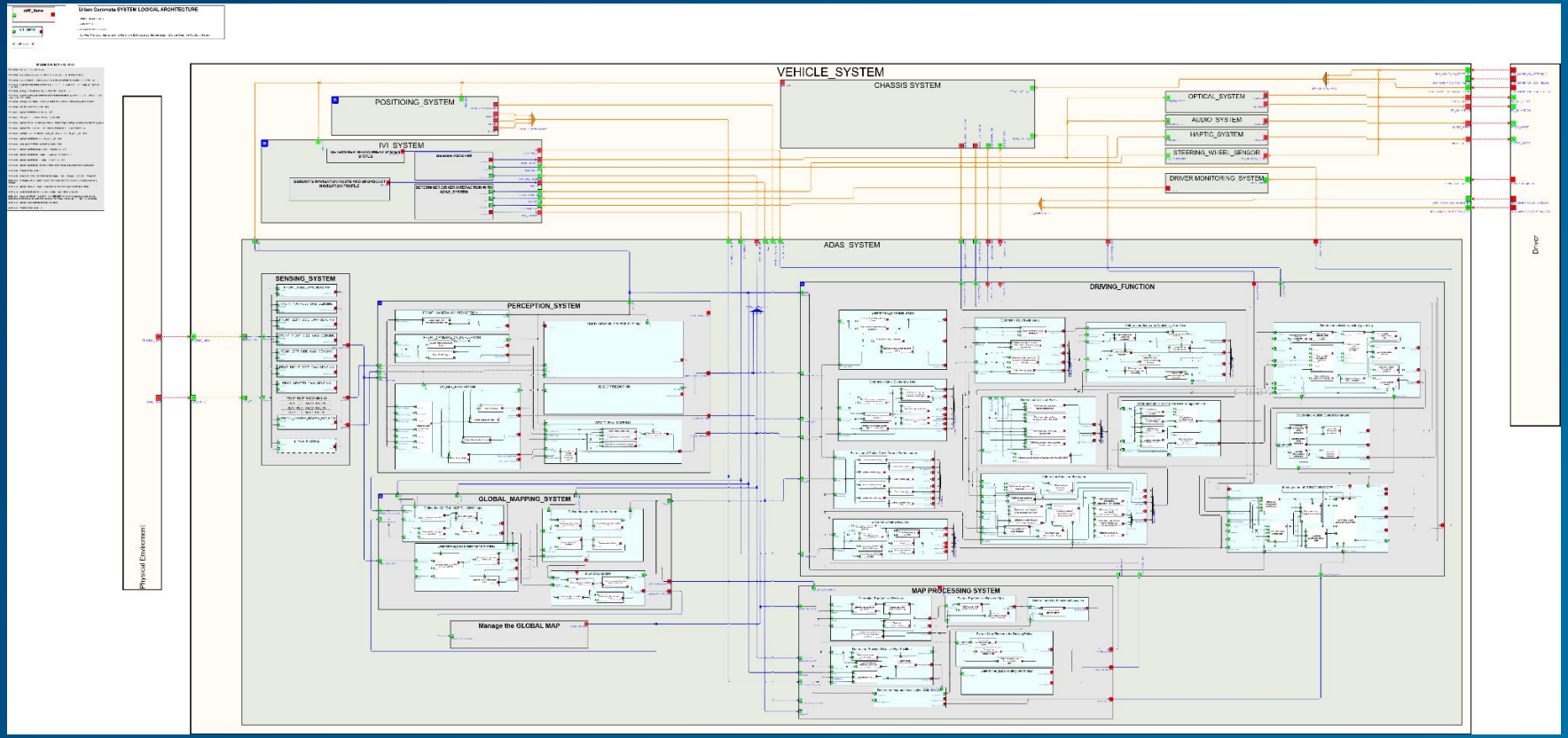
FUNCTION INTRODUCTION

Function Architecture



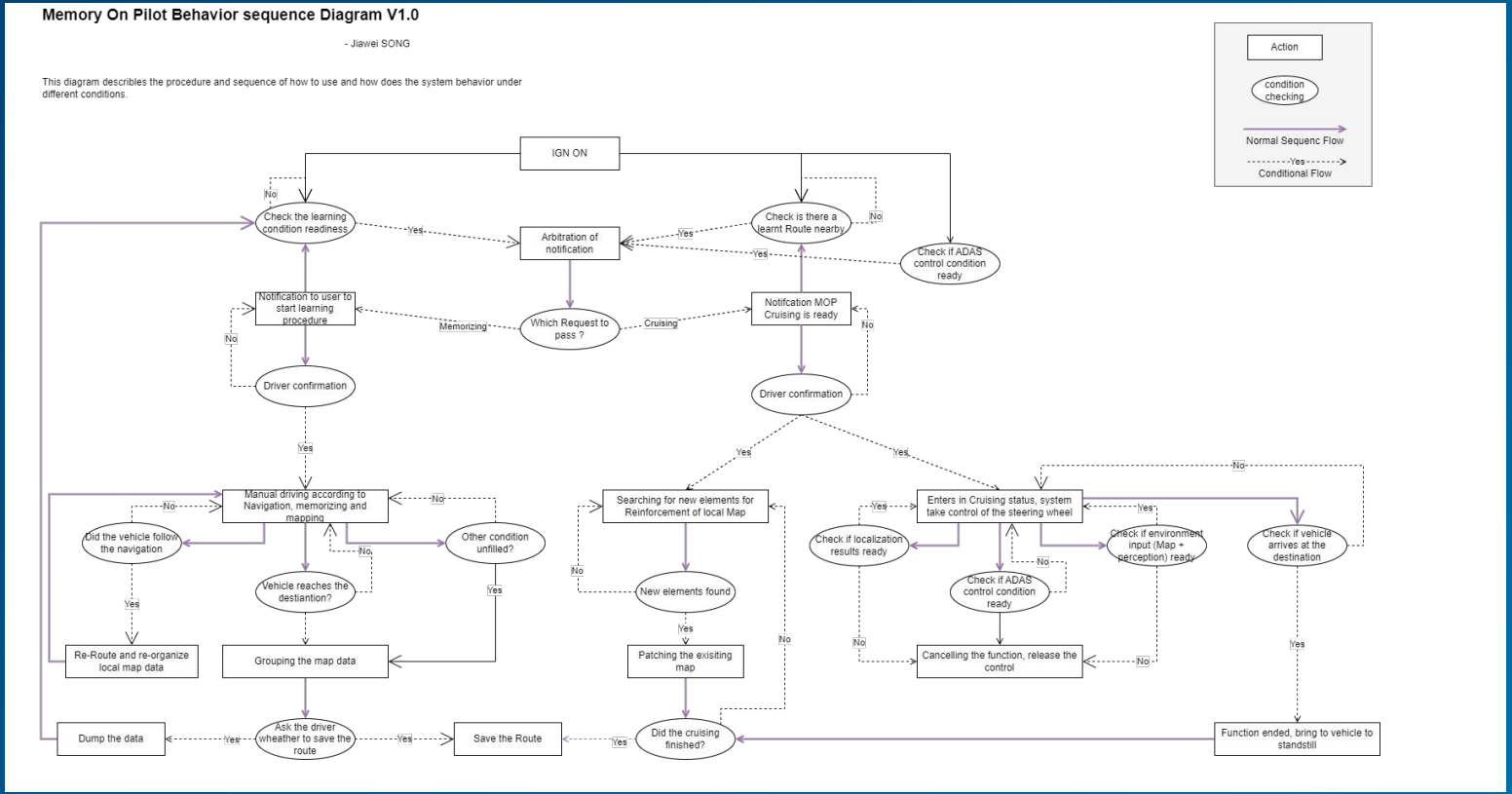
FUNCTION INTRODUCTION

Function Architecture



FUNCTION DESIGN

Function working Procedure

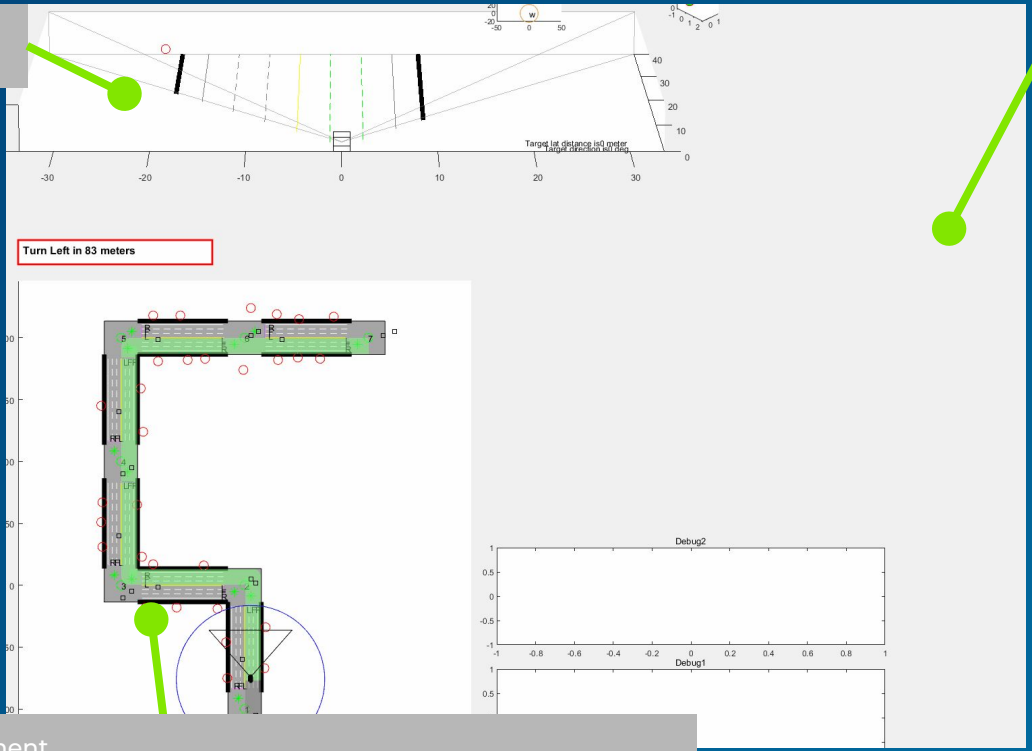


FUNCTION INTRODUCTION

Memorizing - Quick Prototype

1. Recorded Local Map in local map coordinations. Including localization object, semantic information and vehicle trajectory

Front Camera Perception View



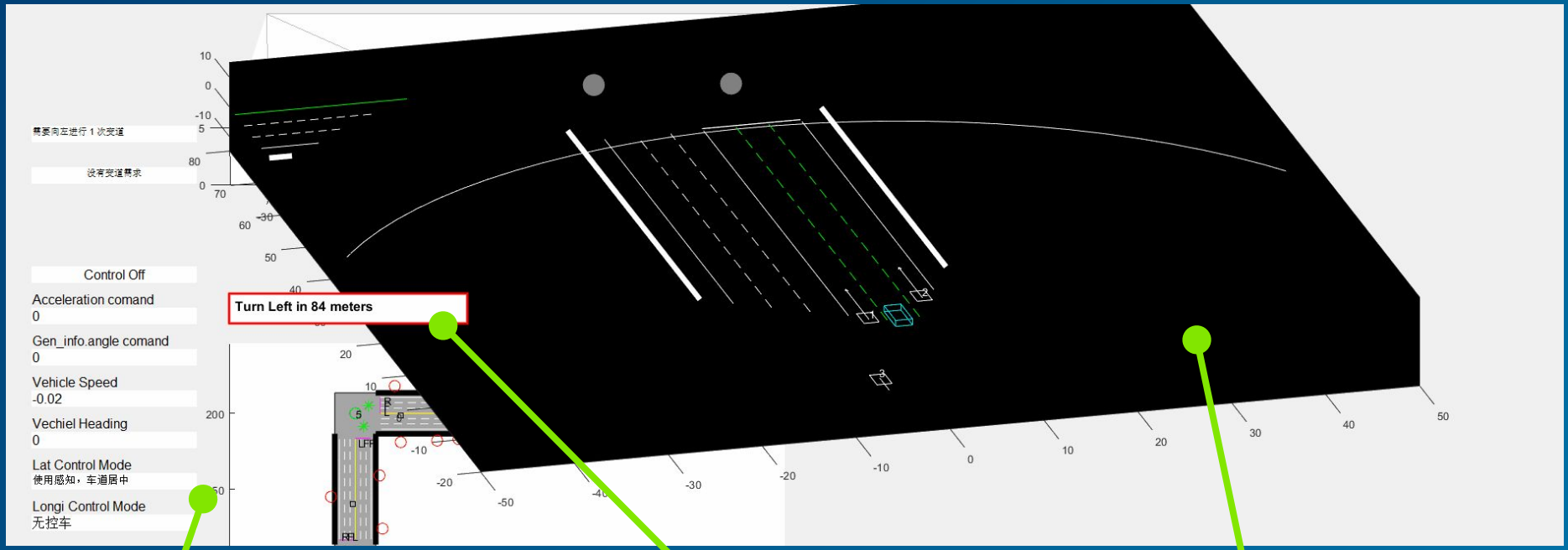
Valeo

Route Memorizing Design Concept

1. BirdView of environment
2. Vehicle model controlled by keyboard simulating driver's maneuver
3. Navigation Route

FUNCTION INTRODUCTION

Quick Prototype - Cruising



State Dashboard

Navigation Input

AD Driving Scenario Simulation

BENCHMARK

Index	Criteria/Feature	DJI Memory Trip			Li Auto Commute NOA (L9)	XPeng (G6)AI Chauffeur	Index	Criteria/Features	
1	处理器型号	高通骁龙8650芯片			高通8155芯片 x 2	Orin-X处理器 X2	1	Processor model	
2	算力单位	32TOPS	80TOPS	200TOPS	508TOPS	508TOPS	2	computing power unit	32TOPS
3	传感器配置	一对前视惯导立体双目摄像头、一个后视单目摄像头、四个环视鱼眼摄像头	一对前视惯导立体双	前视惯导立体双目摄像头、一个后视单目摄像头、四个环视鱼眼摄像头，两个侧视单目摄像头，毫米波雷达、超声波雷达、激光雷达、高精度地图	前向高清摄像头2颗，侧向高清摄像头各一颗，后向高清摄像头2颗，毫米波雷达5颗，超声波雷达12颗粒，激光雷达1颗。	摄像头12个，超声波雷达12个，毫米波雷达5个，激光雷达2个	3	Sensor configuration	A pair of forward-looking stereo binocular cameras, a rear-view monocular camera, and four surround-view fisheye cameras
4	是否需要高精地图支持	否	否	是	否	否	4	need high-precision map support	NO
5	是否需要机光雷达支持	否	否	是	是	是	5	need lidar support	NO
6	最大存储路径数量	10	10	10	多条	多条	6	Maximum number of storage paths	
8	形成记忆前需要人工开过的次数和时间	至少一次，次数越多越成熟			至少一次，2-3周完成训练	一次100%形成	8	he that needs to be manually opene	The number of times ar
9	车道保持	Y	Y	Y	Y	Y	9	lane keeping	Y
10	自适应巡航	Y	Y	Y	Y	Y	10	adaptive cruise	Y
11	自动变道	Y	Y	Y	Y	Y	11	automatic lane change	Y
12	交通标志识别	N	Y	Y	Y	Y	12	traffic sign recognition	N
13	红绿灯识别与自动启停	Y	Y	Y	Y	Y	13	ht recognition and automatic start	Y
14	路口左/右转（基于交通灯信号）	N	Y	Y	Y	Y	14	Turn left/right at intersection (based on traffic light signals)	N
15	避障绕行	N	Y	Y	Y	Y	15	Obstacle avoidance and detour	N
16	近距离加塞避让	N	Y	Y	Y	Y	16	Avoid blocking at close range	N
17	礼让行人	N	Y	Y	Y	Y	17	Yield Here To Peds	N
18	智能调速	Y	Y	Y	Y	Y	18	Intelligent speed regulation	Y
19	拨杆变道	Y	Y	Y	Y	Y	19	Shift lever to change lanes	Y
20	人机共驾	Y	Y	Y	Y	Y	20	Human-machine co-driving	Y
21	高速ETC收费站通行	N	N	Y	Y	Y	21	g through the expressway ETC toll s	N
22	自动上下匝道	N	Y	Y	Y	Y	22	Automatic on and off ramps	N
23	最长可记忆距离	最长可记忆100公里			>=86公里	最长可记忆100公里	23	The longest memorable distance	
24	其他特色功能	惯导立体双目技术支持不规则障碍物识别和绕行。			BEV+激光雷达+高精地图,昏暗或强光下躲避事故车	夜间或光线严重不足的环境下，小鹏汽车的AI代驾表现和白天几乎没有分别。	24	Other features	Inertial navigation stereoscopic