

Mapping and Navigating in a Hectic World

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Who is Alibaba



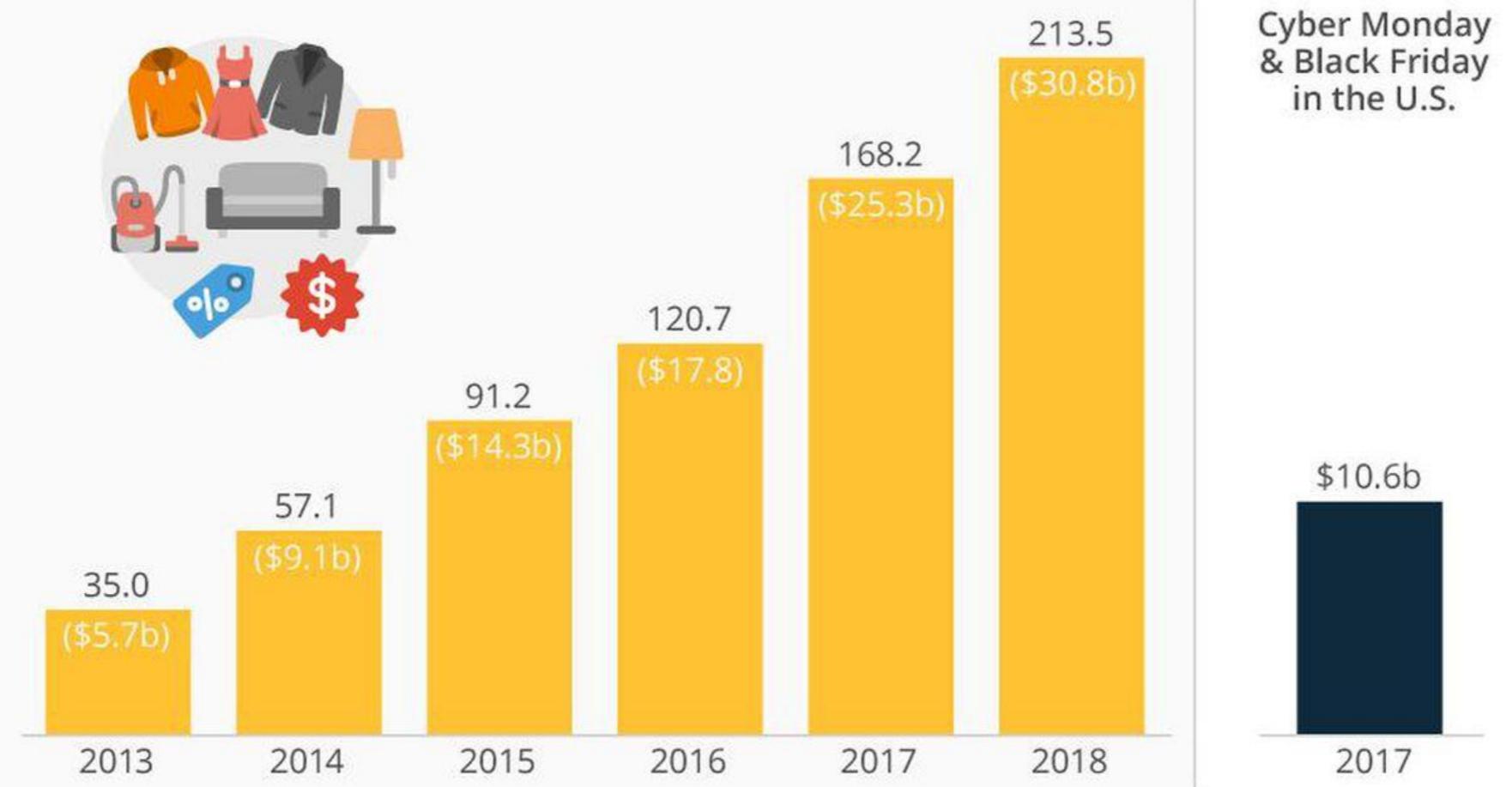
Alibaba @ Hangzhou



Alibaba in E-commerce

Singles' Day Sets Another Sales Record

GMV for Alibaba on Singles' Day compared to Black Friday & Cyber Monday* (in RMB)



@StatistaCharts

* Gross merchandise volume; U.S. figure for Black Friday and Cyber Monday is total e-commerce sales.

Source: Alibaba via Techcrunch

Alibaba Eco-System



Who is Amap (AutoNavi)?

No.**1** Mapping and Navigation Company in China



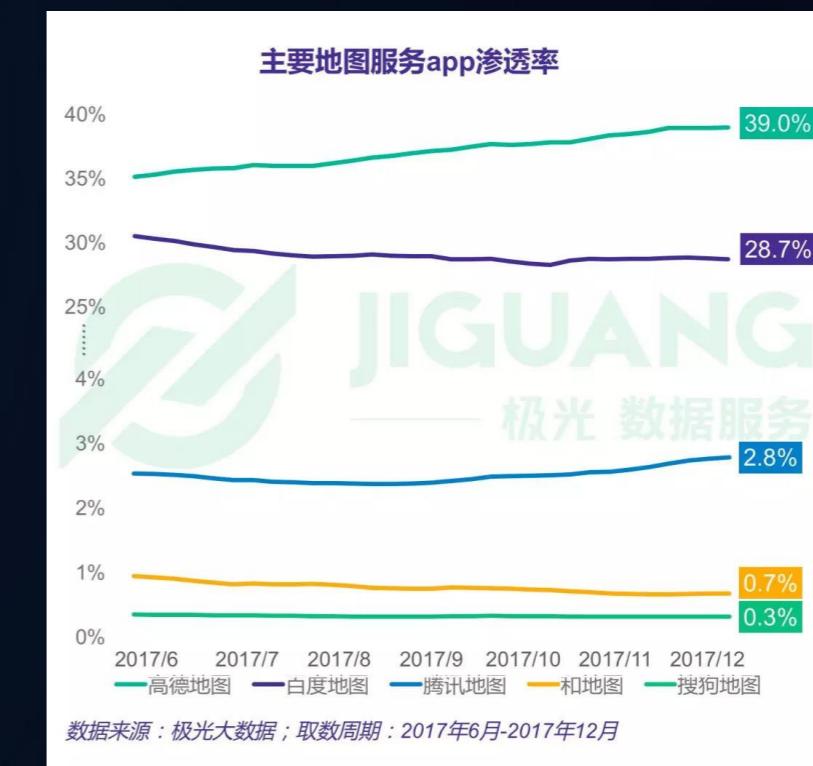
426M active users
(QuestMobile 2018/07)



8.2M km roads



70M POI



← Amap

Who is Amap (AutoNavi)?

No.**1** Map in China and No.**1** Human-Location Relations



426M active users
(QuestMobile 2018/07)



8.2M km roads



70M POI

People & Activities



Locations & Places

Who is Amap (AutoNavi)?

No.**1** Map in China and No.**1** Human-Location Relations



426M active users
(QuestMobile 2018/07)



8.2M km roads



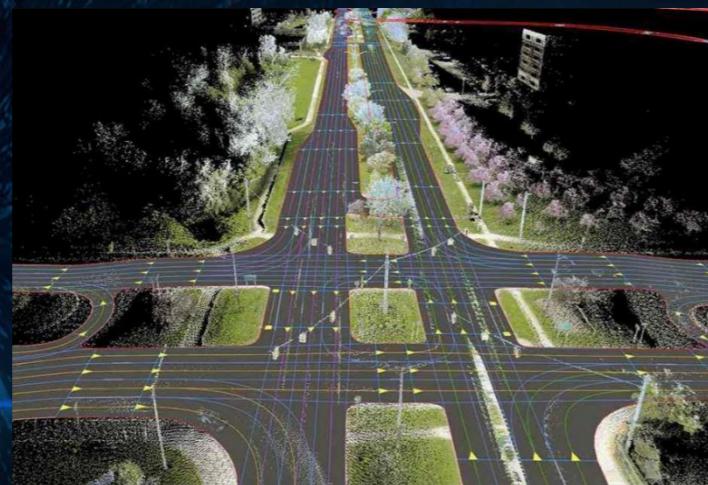
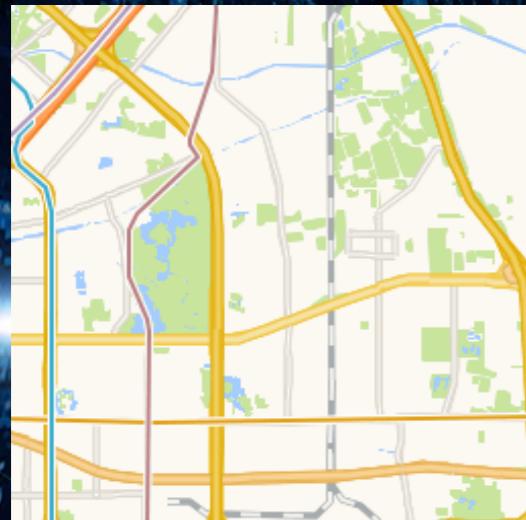
70M POI



..... Upper Body

..... Lower Body

Computer Vision @ Amap



SD Map

HD Map

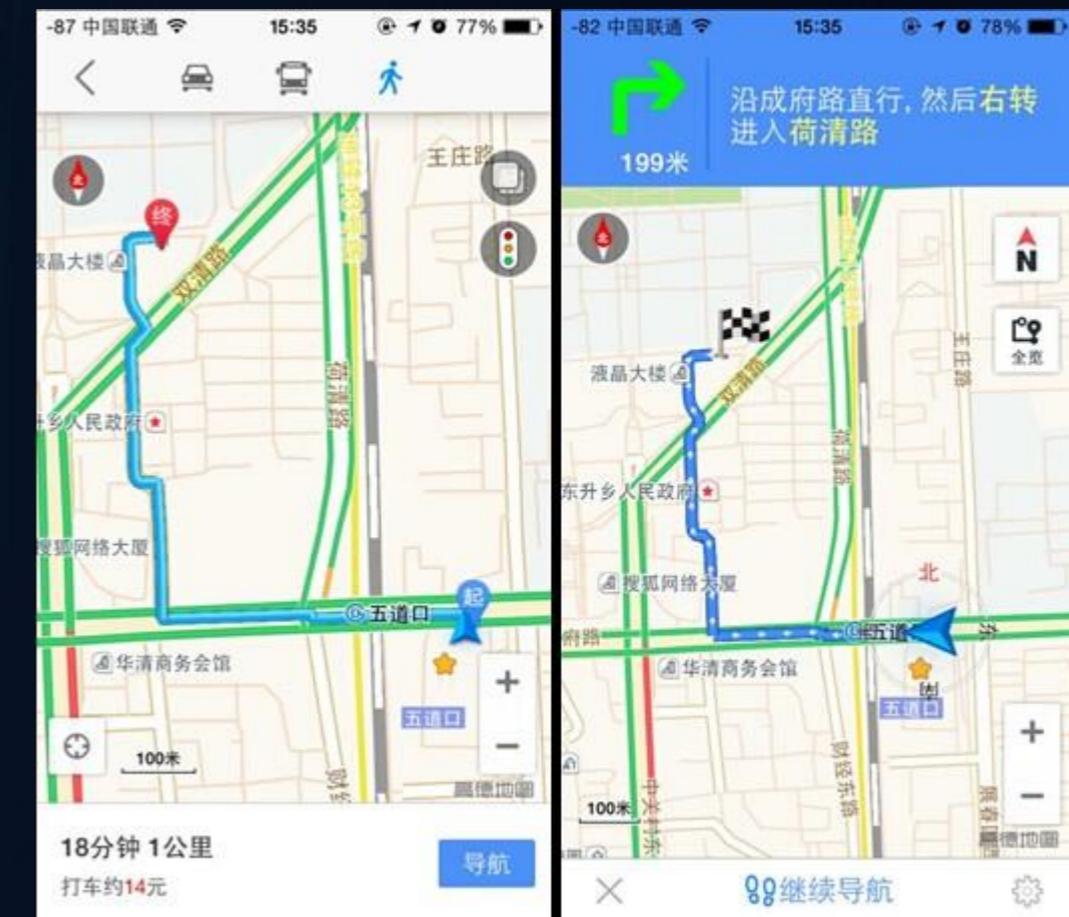
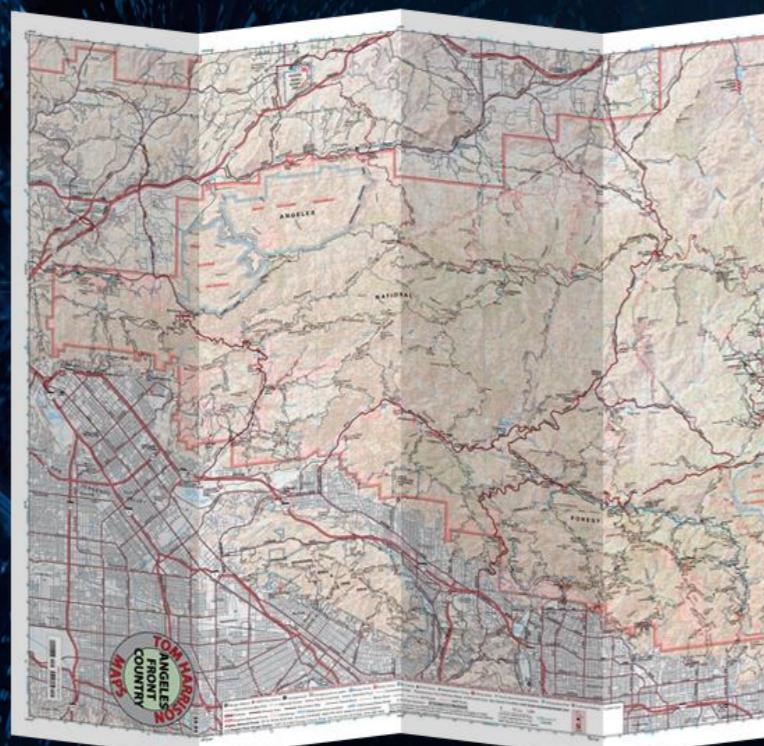
Mapping Automation

Location

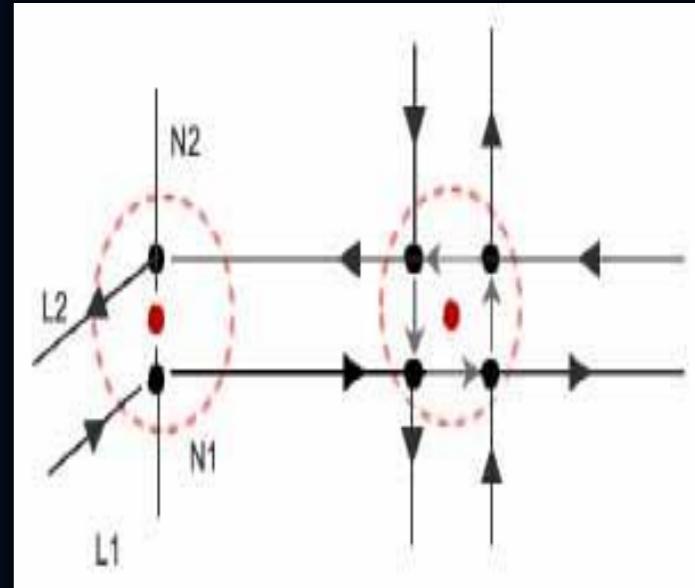
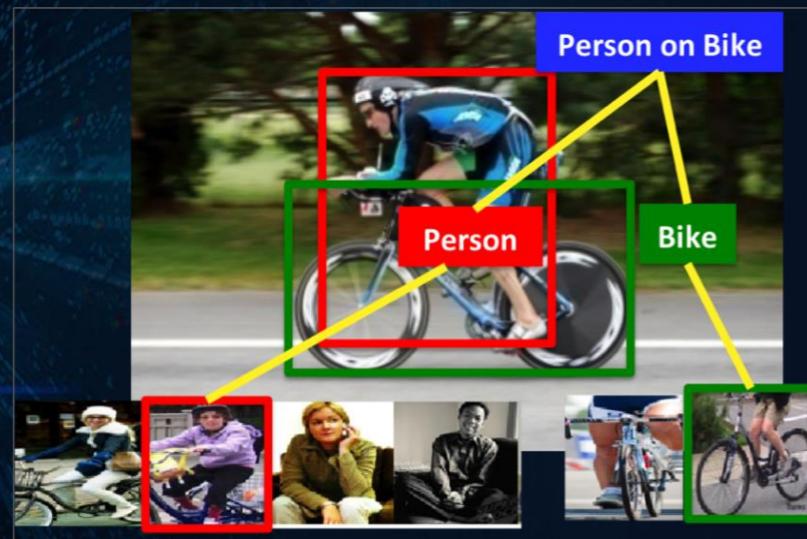
AR Navigation

“Easy” Navigation

Under the Hood



Basic Pipeline of Map Production



Data
Acquisition



Automatic
Recognition

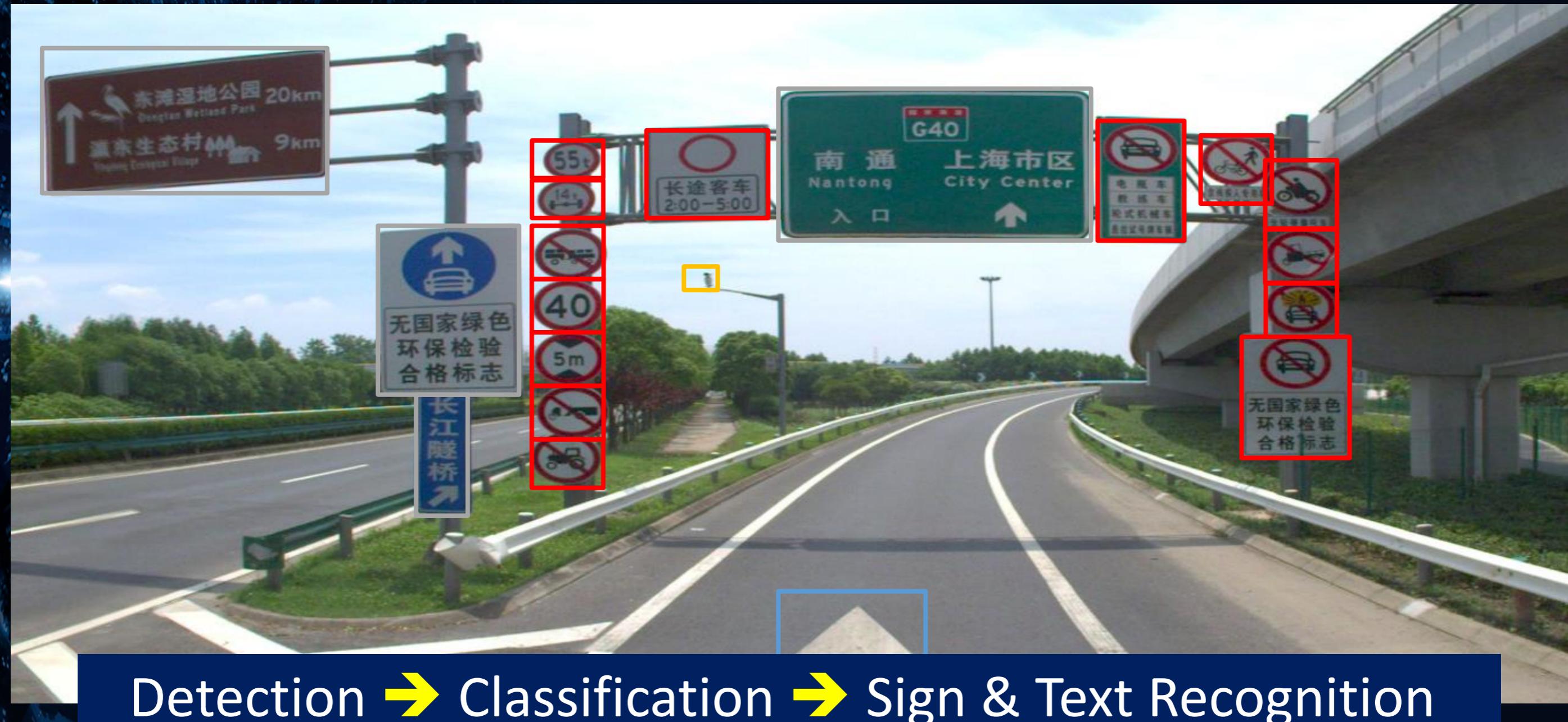


Fusion &
Human Editing



Map Database
& Service

Auto-Generation of Road Data



Detection → Classification → Sign & Text Recognition

Auto-Generation of Road Data



a. “not allowed”

b. long-distance coach

c. 2:00-5:00

1. Detection & Classification

2. Parsing & Text Reading

Why is Mapping (still) a Problem?



Map is a “deep” business

... and it's hard in a hectic world

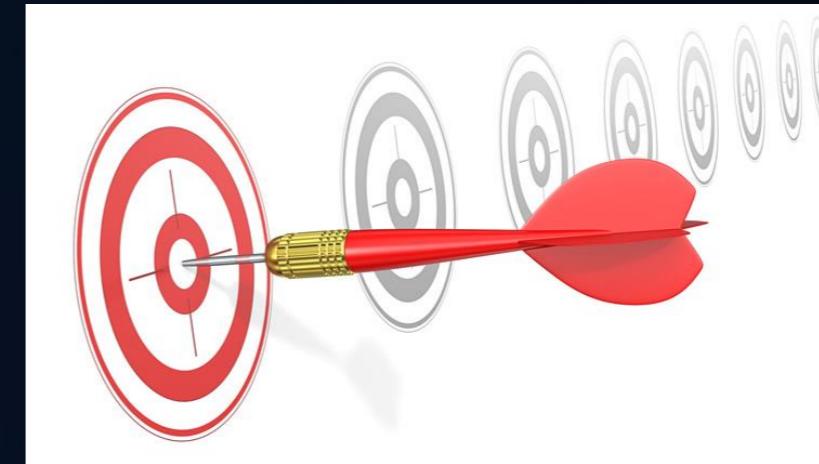
Mapping is a “Deep” Business



Scale (and diversity)



Complexity (and specification)



Accuracy (and updating)



Cost (and data quality)

Challenge: Data Quality



Challenge: Data Quality



Distortion
Reflection
Occlusion

Resolution
Compression
Image quality

... ...

Auto Calibration in the Wild



Unknown camera: focal length, distortion, height and pose

Solution: combine multiple data sources

Image Enhancement

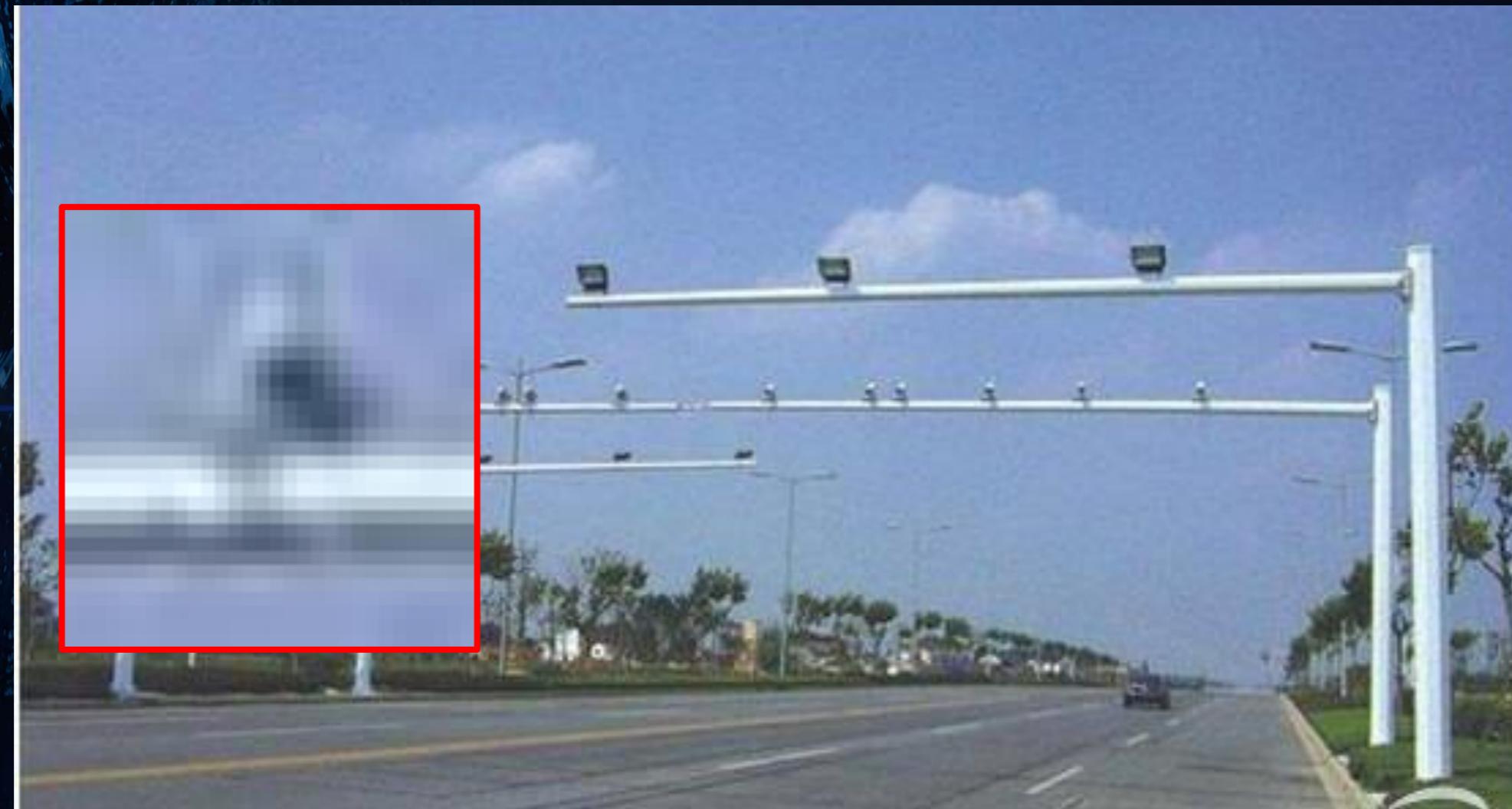


Original

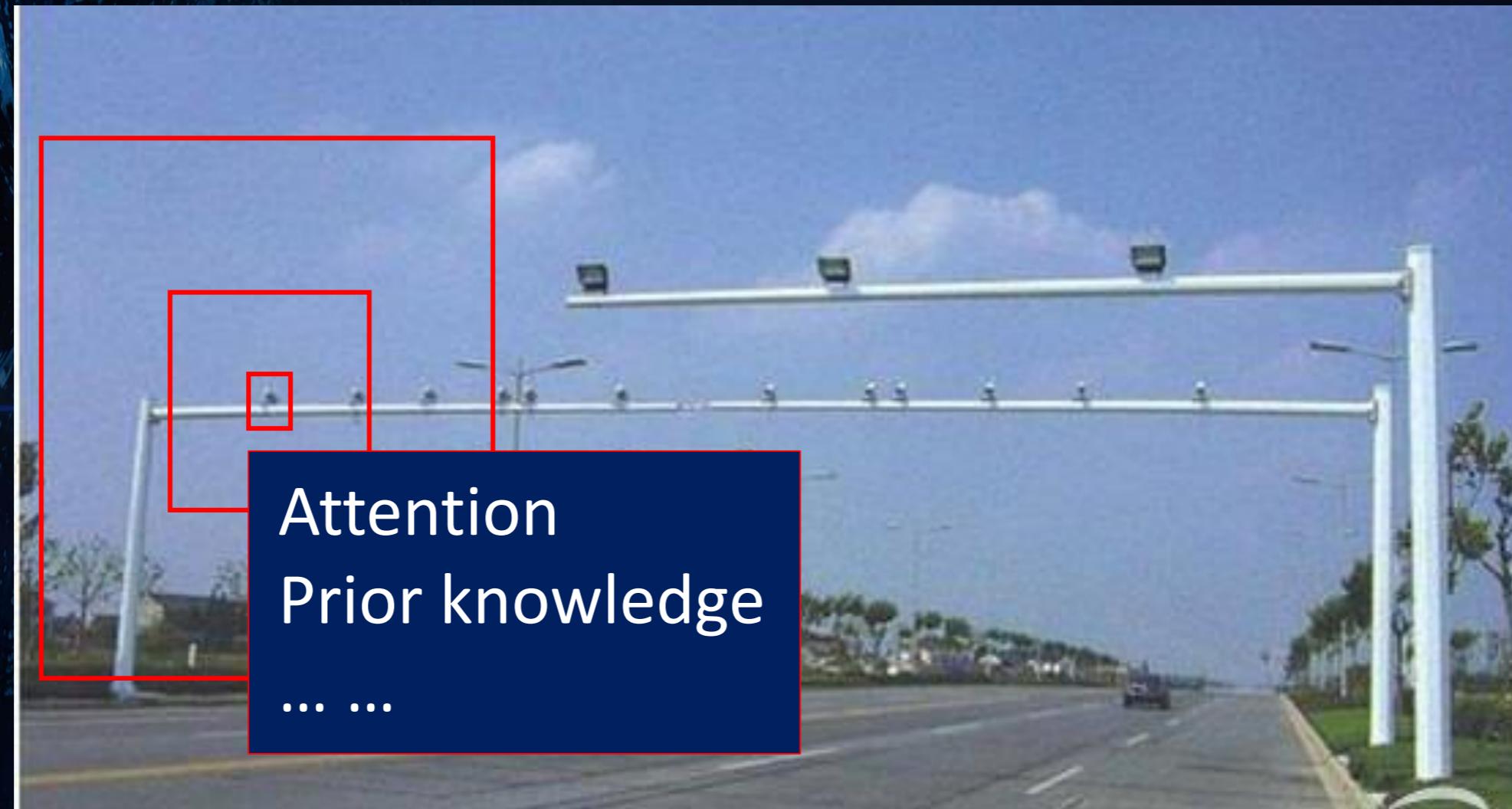
Challenge: Small Objects



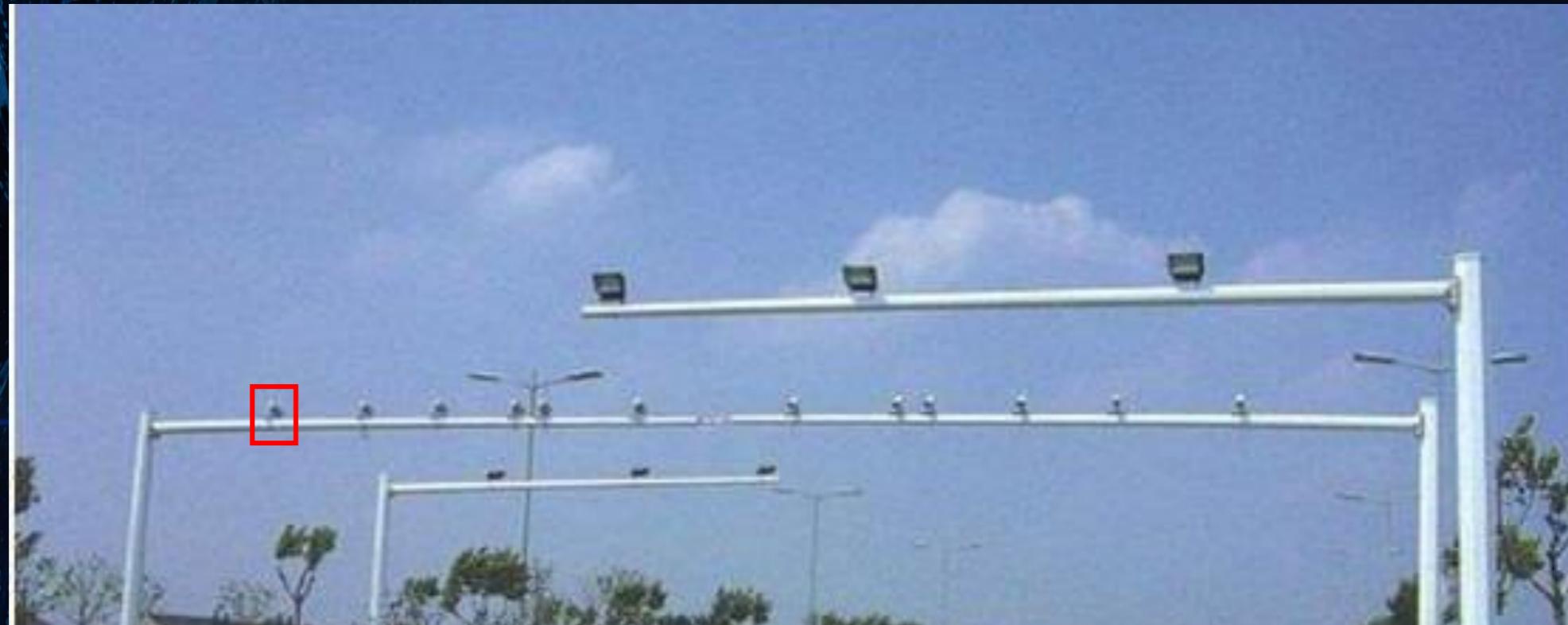
Challenge: Small Objects



Challenge: Small Objects



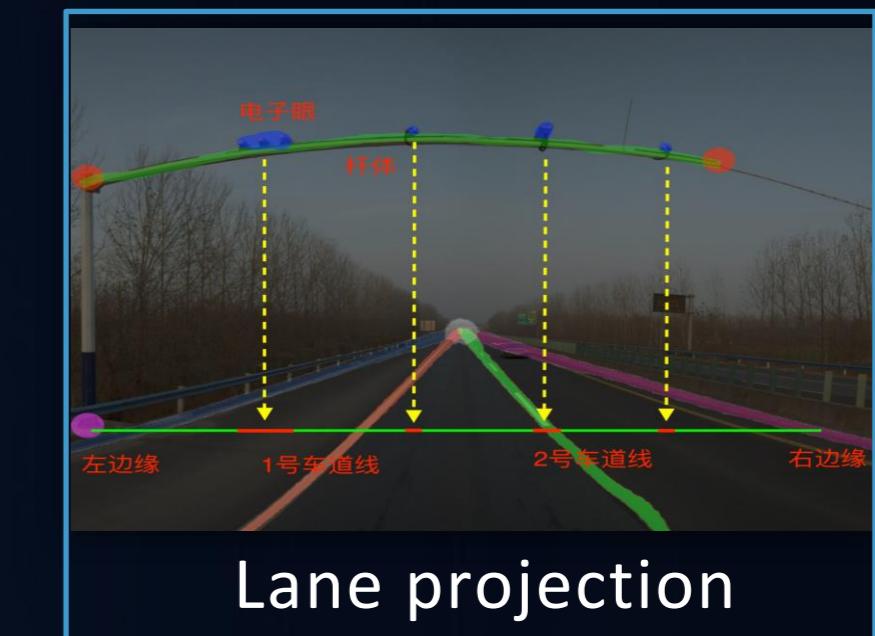
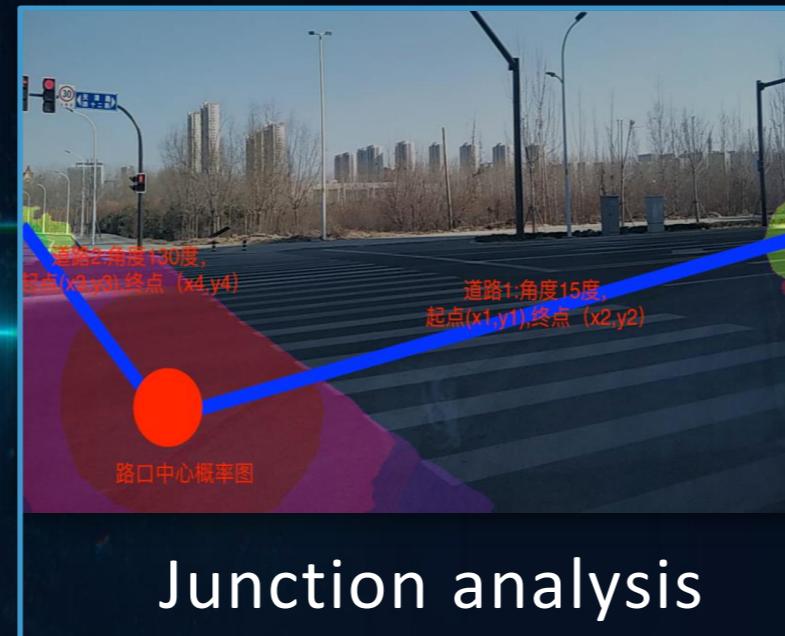
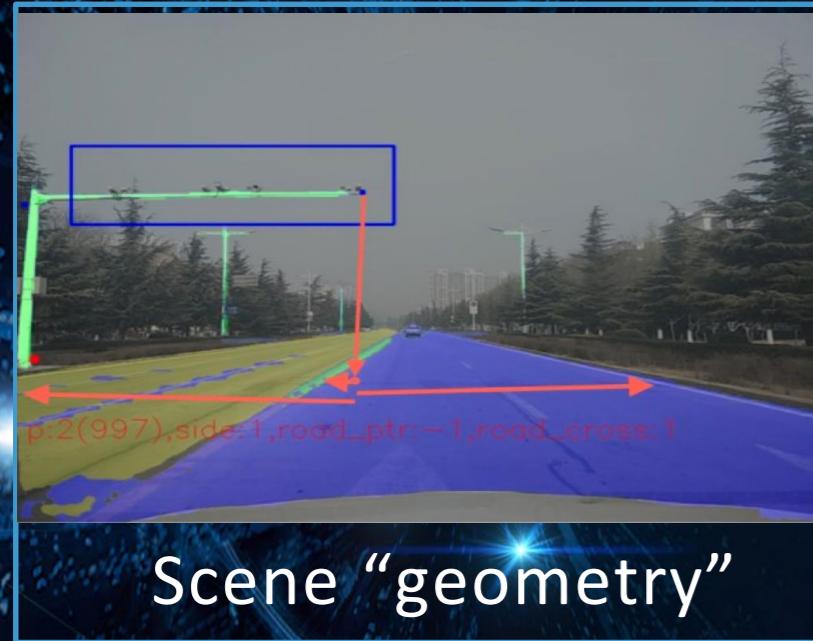
Challenge: Scene Complexity



Does this electronic eye belong to the current road? Which lane?



Challenge: Scene Complexity



- Object detection
- Semantic segmentation
- Scene understanding
- Geometry and calibration

Challenge: Scene Complexity



Challenge: Scene Complexity



Challenge: Ambiguity



Challenge: Ambiguity



Challenge: Ambiguity



Challenge: Frequent Changes

(b)

WSJ
Live

Change Detection



- Object matching
Feature + deep learning
- Context matching
Segmentation + relations
- Scene matching
Feature + deep learning

Challenge: Ambiguity

Can cars turn here?

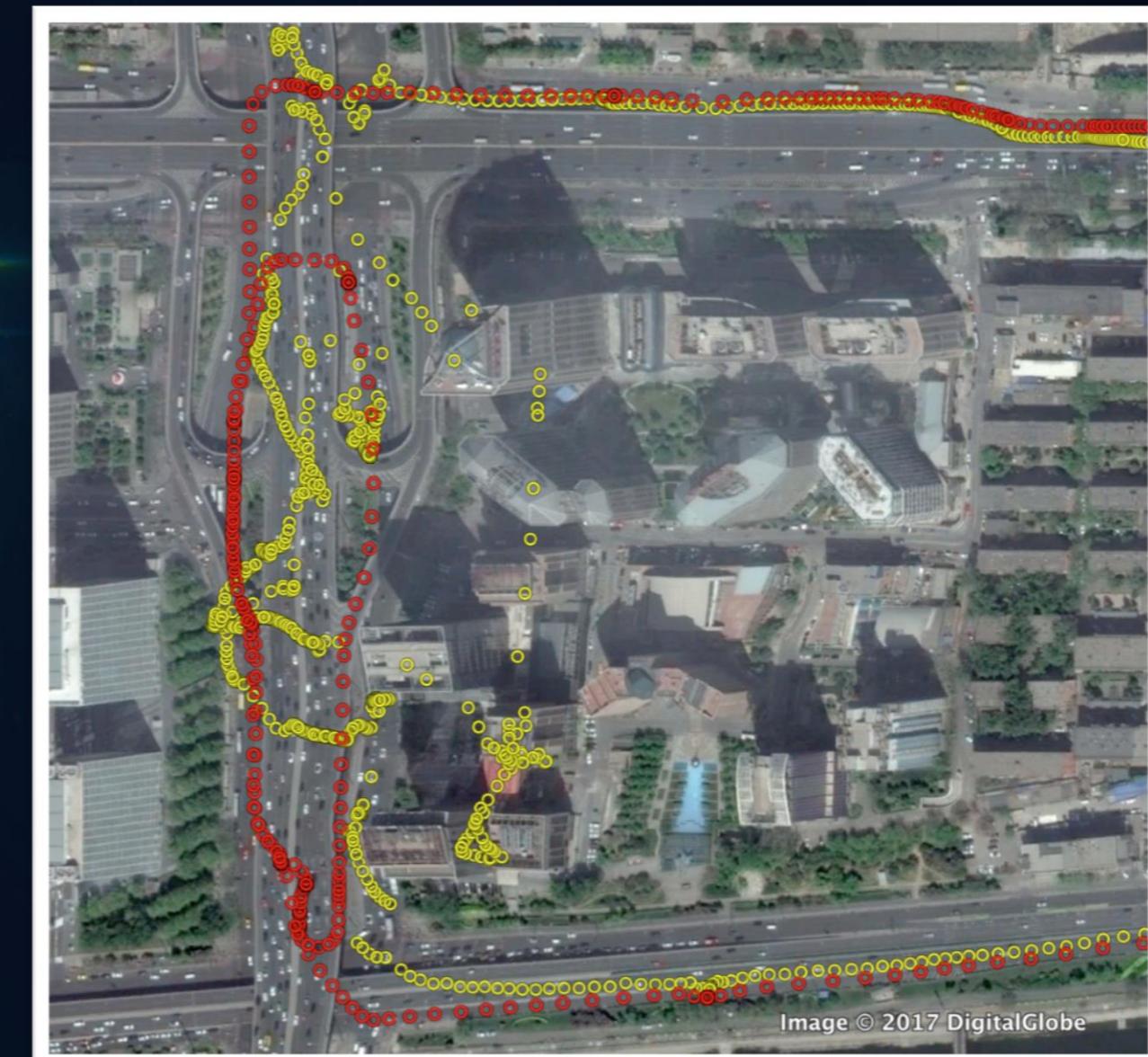
Solution: Vision + GPS



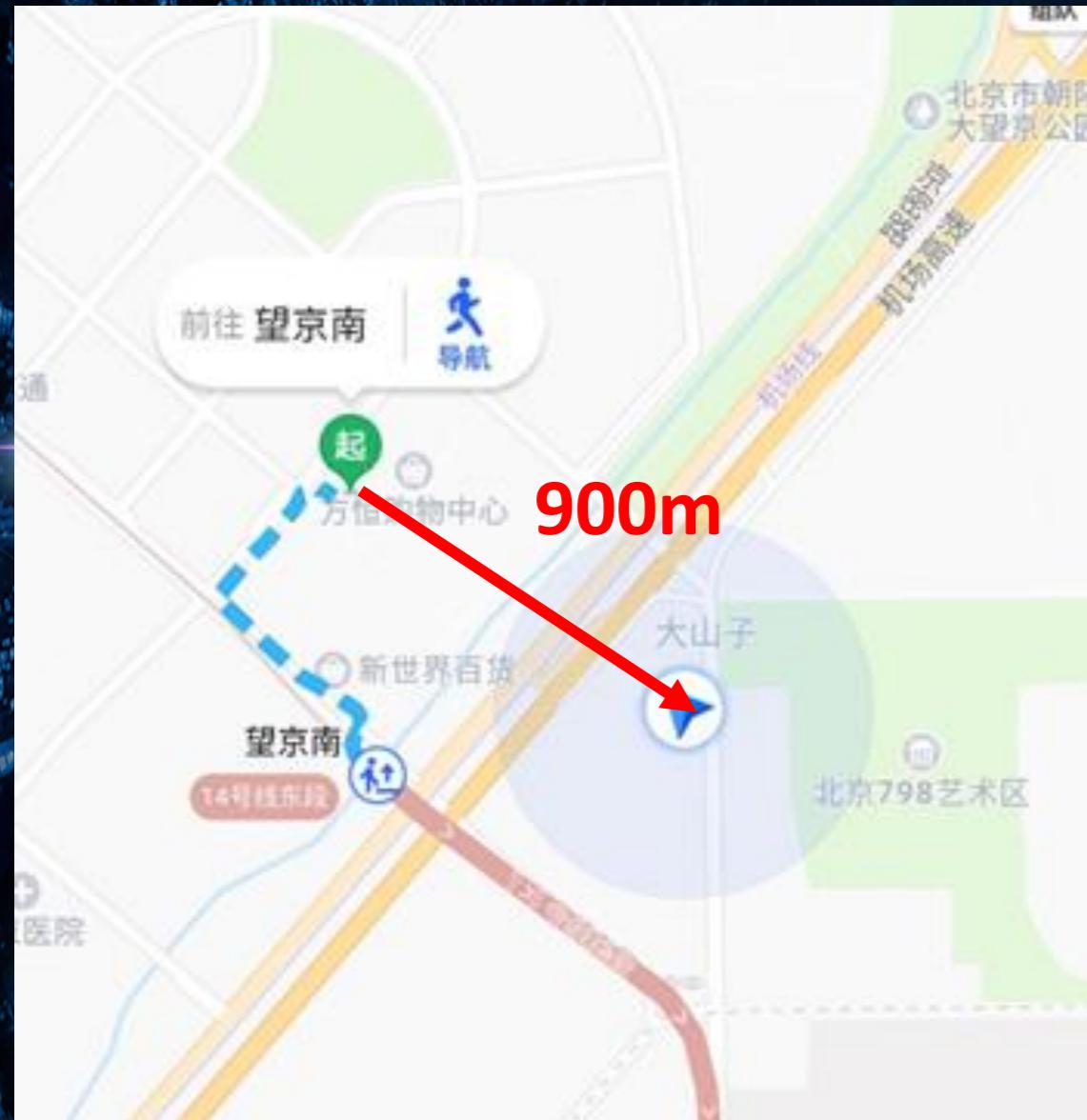
Challenge: Location



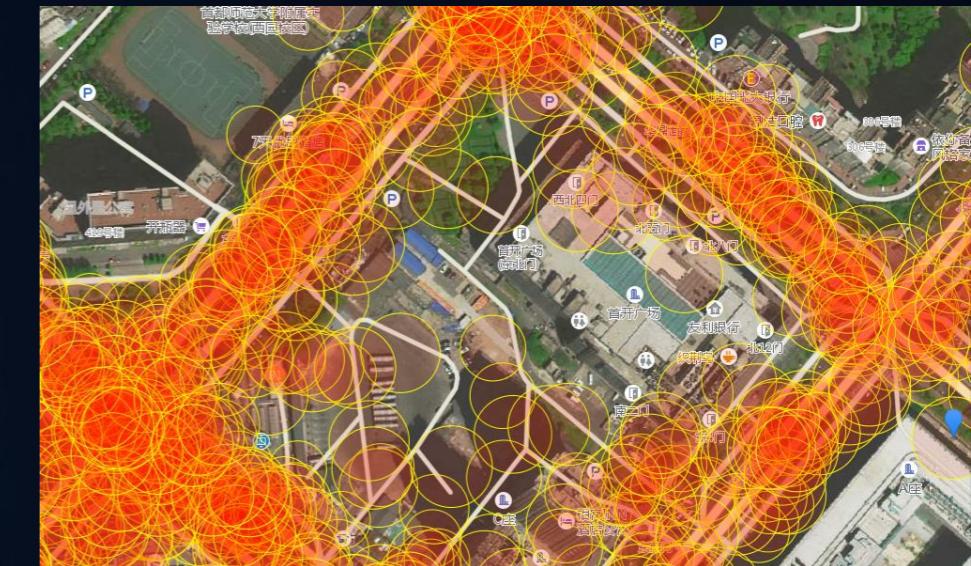
Urban Canyon



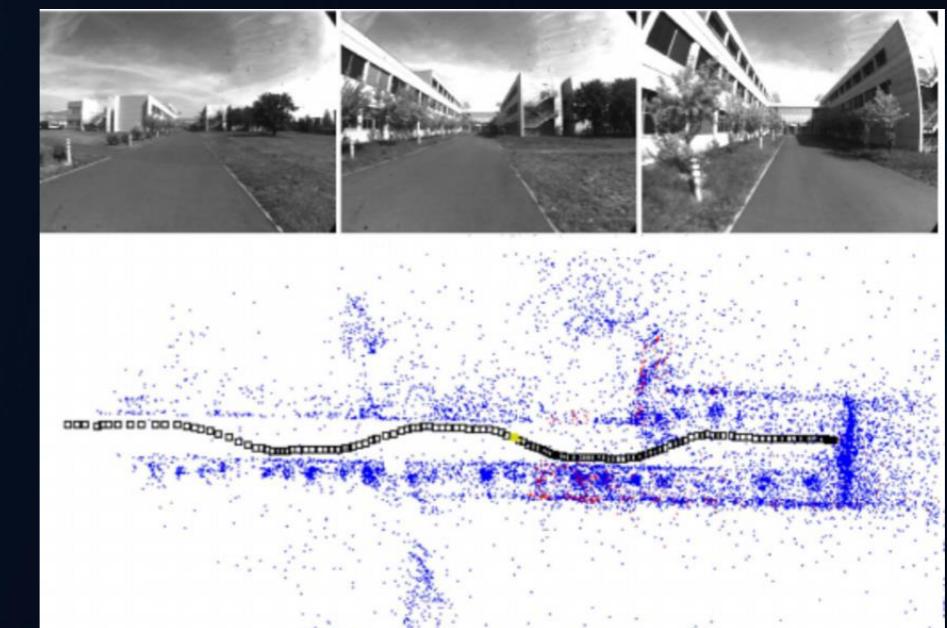
Challenge: Location



WiFi



Vision



How We Solve Problems in Practice

- Data quality, including annotation
- Data quantity, esp. failure cases
- Iterative improvements (and leaps)
- Combining algorithms from multiple angles
- Human-computer collaboration

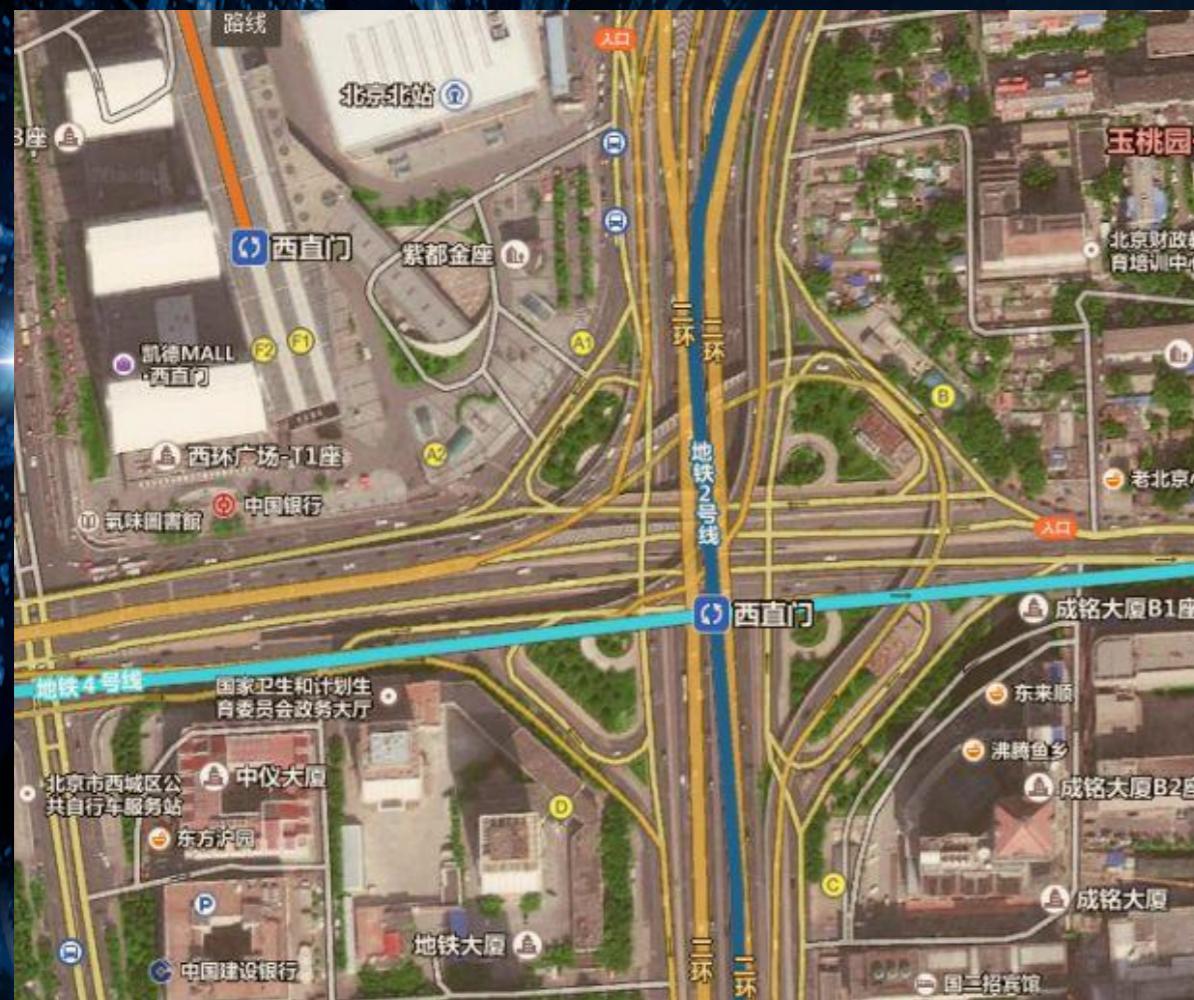
Still, Reality Can Beat You



Still, Reality Can Beat You



Still, Reality Can Beat You



Next-Gen Navigation



- Accurate map
- Accurate location
- “Easy” directions

Abstract vs WYSIWYG



Abstract vs WYSIWYG



AR Navigation



Launched April 2019

AR Navigation

AR导航 vs 传统导航
更好的解决了哪些用户痛点？

Challenge: Minimal Sensing

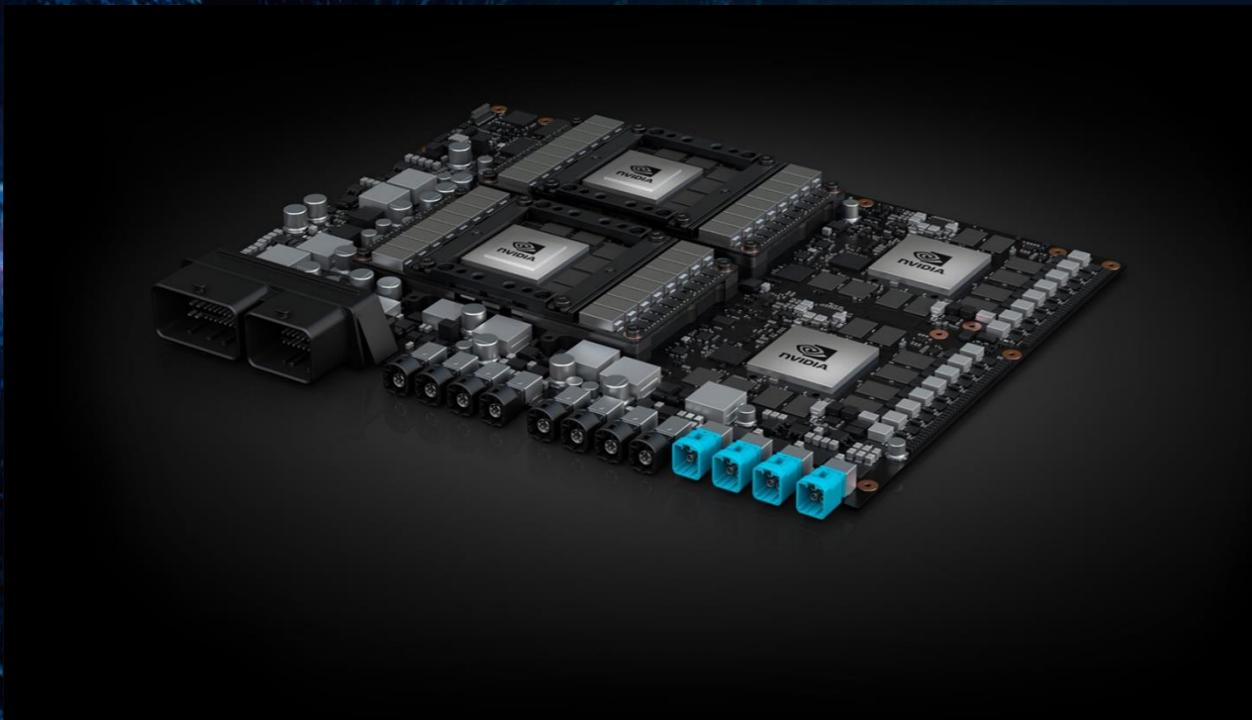
UBER ATC

The diagram illustrates the sensor configuration of an Uber Autonomous Test Vehicle (ATC). A white Ford Fusion car is shown from a front-three-quarter perspective. Various sensor components are highlighted with callout boxes:

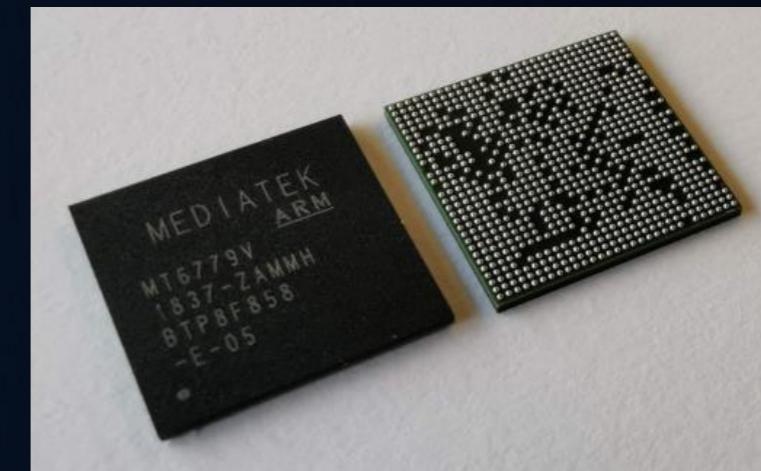
- Top mounted lidar units:** Provide a 360° 3-dimensional scan of the environment.
- Forward facing camera array:** Focuses on both close and far field, watching for oncoming vehicles, crossing pedestrians, traffic lights, and signage.
- Front, rear, and wing mounted lidar modules:** Aid in the detection of obstacles in close proximity to the vehicle as well as smaller ones that can get lost in blind spots.
- Side and rear facing stereo camera pairs:** Work in collaboration to construct a continuous view of the vehicle's surroundings.
- Roof and trunk mount antennae:** Provide GPS positioning and wireless data capabilities.
- 360° radar coverage:** Provides additional sensing around the vehicle.
- Custom designed compute and storage:** Allows for real-time processing of data, with a fully integrated cooling solution keeping components running optimally.

A photograph showing a person's hands mounting a black GoPro Hero camera onto a silver side-view mirror of a car. The car's interior dashboard and steering wheel are visible in the background through the windshield. The scene is set outdoors with blurred greenery in the distance.

Challenge: Minimal Compute

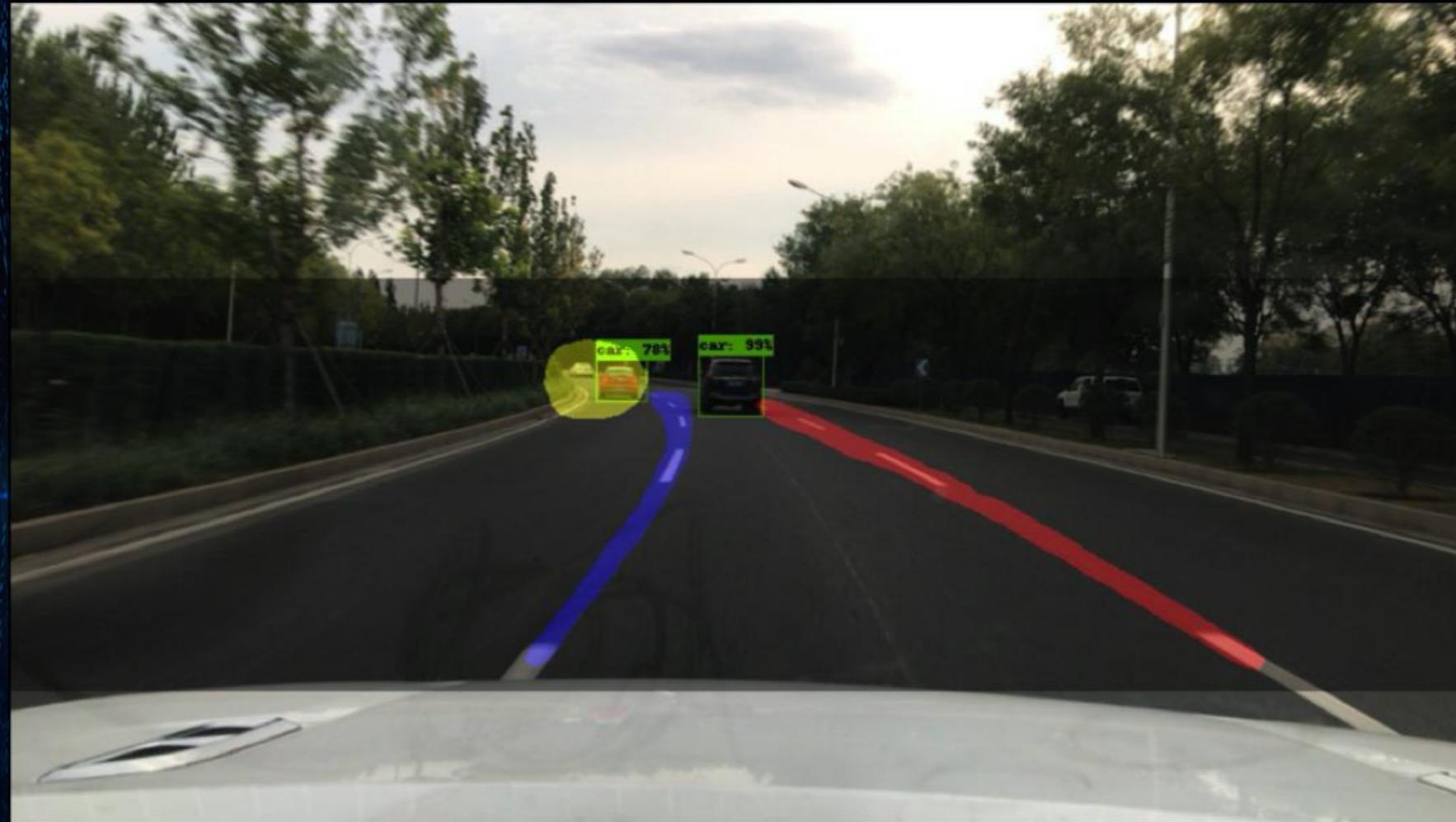


Nvidia DRIVE AGX



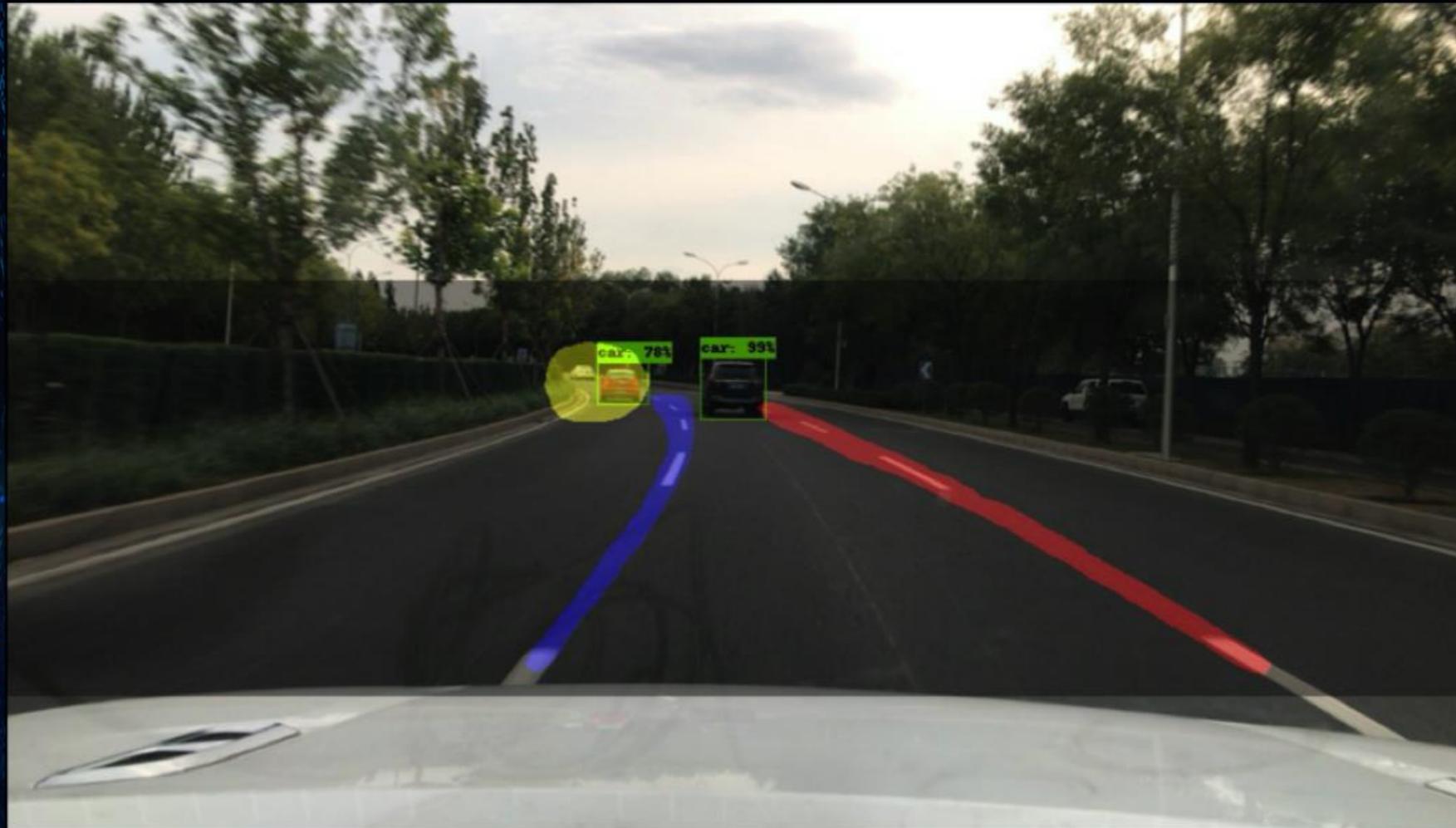
MTK8783

AR Navigation: Car Detection



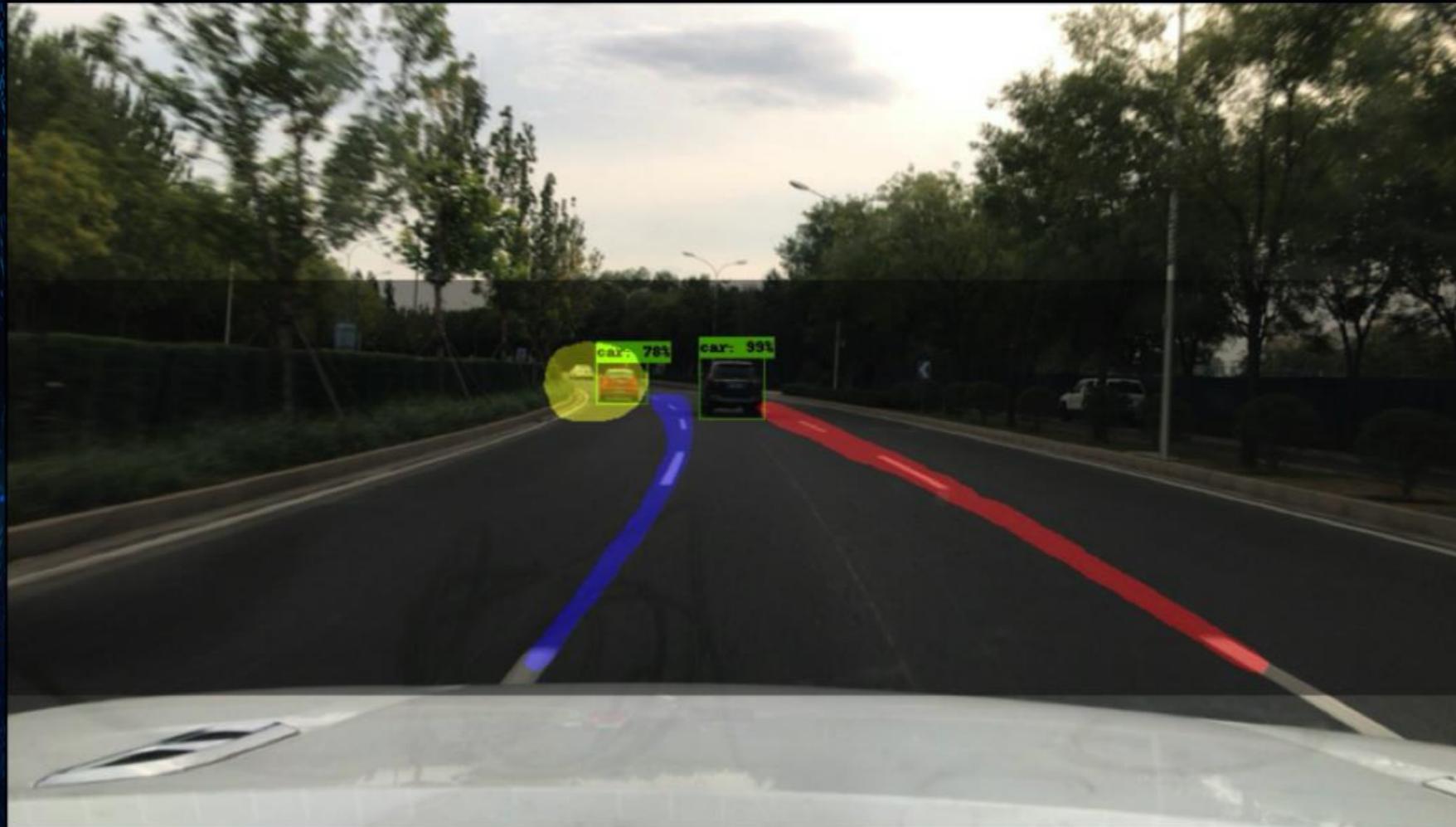
(1) model compression (2) utilize scale (3) combine with tracking

AR Navigation: Lane Boundary Detection



(1) multi-task (2) curve fitting (3) weighting and loss

AR Navigation: Direction and Location



- (1) multi-task (2) use segmentation for prediction
- (3) use regression to predict lane number (4) combine with GPS

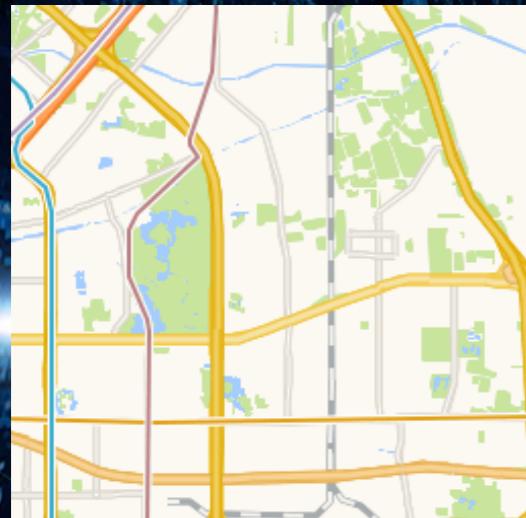
AR Navigation: Compute



1/5 of typical smartphone

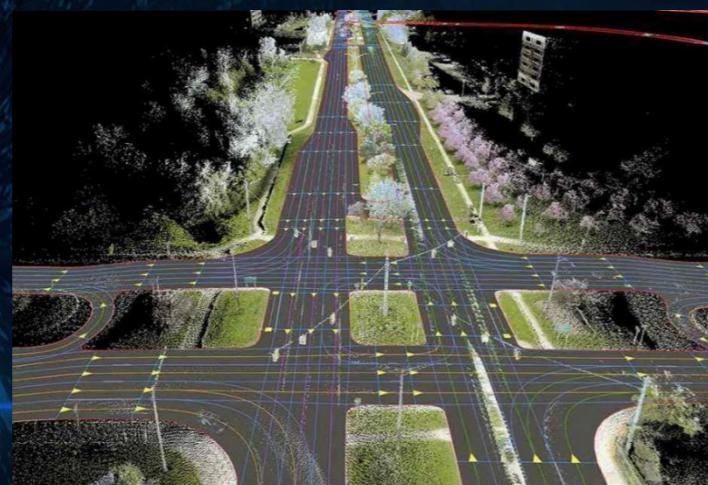
- (1) Multi-tasking model
- (2) Model compression
- (3) Optimize implementation
- (4) Balance GPU/CPU (and transfer)
- (5) Reduce context switching
- (6) ... and the rest of the system

Computer Vision @ Amap

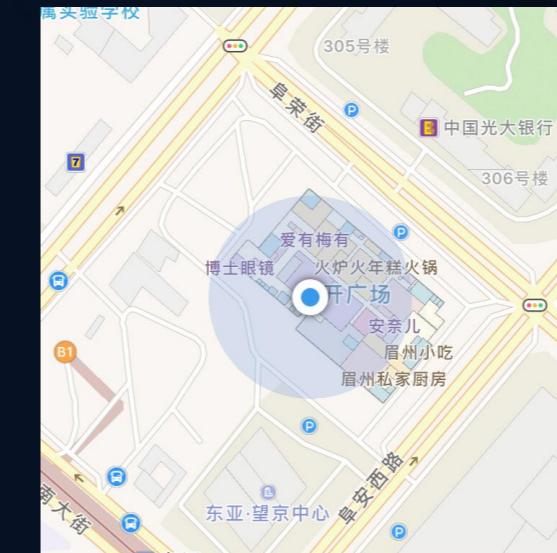


SD Map

Mapping Automation



HD Map



Location

“Easy” Navigation



AR Navigation

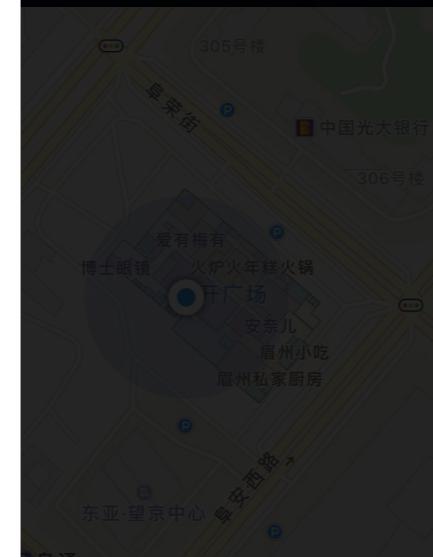
Computer Vision @ Amap

Alibaba's AutoNavi commercializes HD map by charging automakers license fee

By Robert Fri Apr 12 2019

Alibaba-backed online mapping service AutoNavi is commercializing its mapping service by charging the company's automobile partners for using its high-definition (HD) map, which is a critical piece in self-driving solutions, local financial news outlet *Lanjinger* reported.

AutoNavi is charging automakers RMB 100 (USD 15) per car per year for licensing the HD map, which captures the world with centimeter-precision whereas ordinary web map apps represents the world at a meter-level accuracy.



Location

AR Navigation

“Easy” Navigation

SD M
Map

The Future of Mapping and Navigation

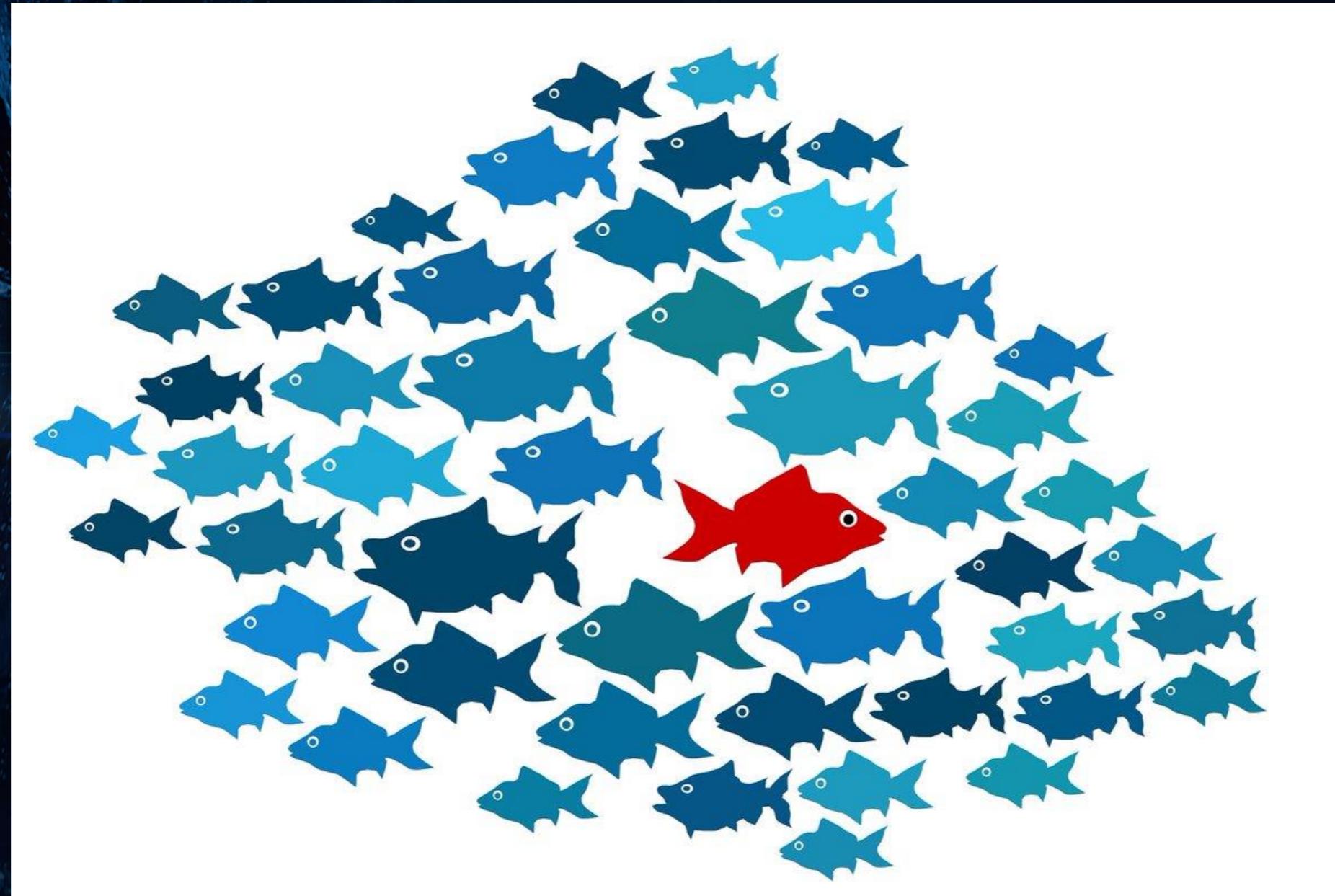


People driving cars



Machine driving cars

The Future of Mapping and Navigation

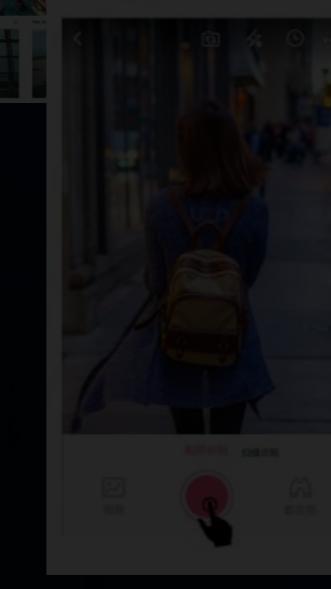
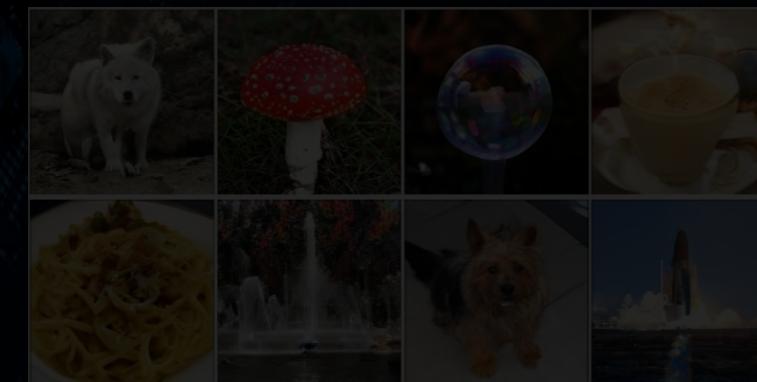
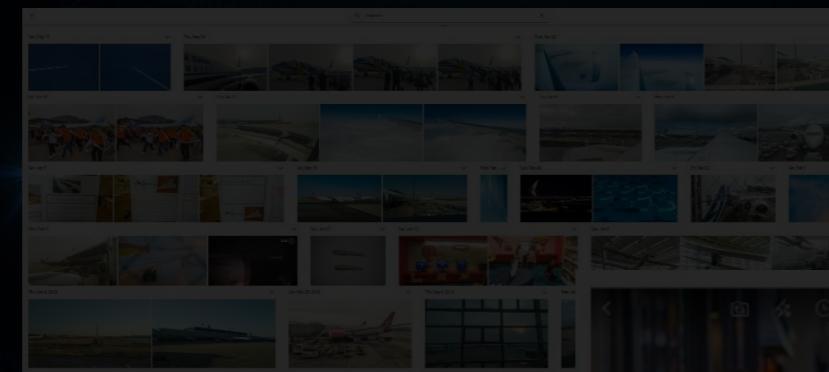
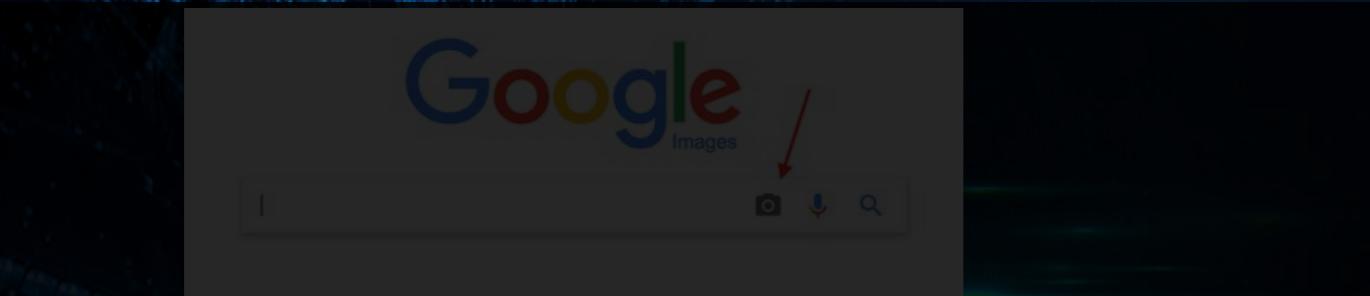




连接真实世界 让出行更美好

Computer Vision Applications

Cloud | Real World

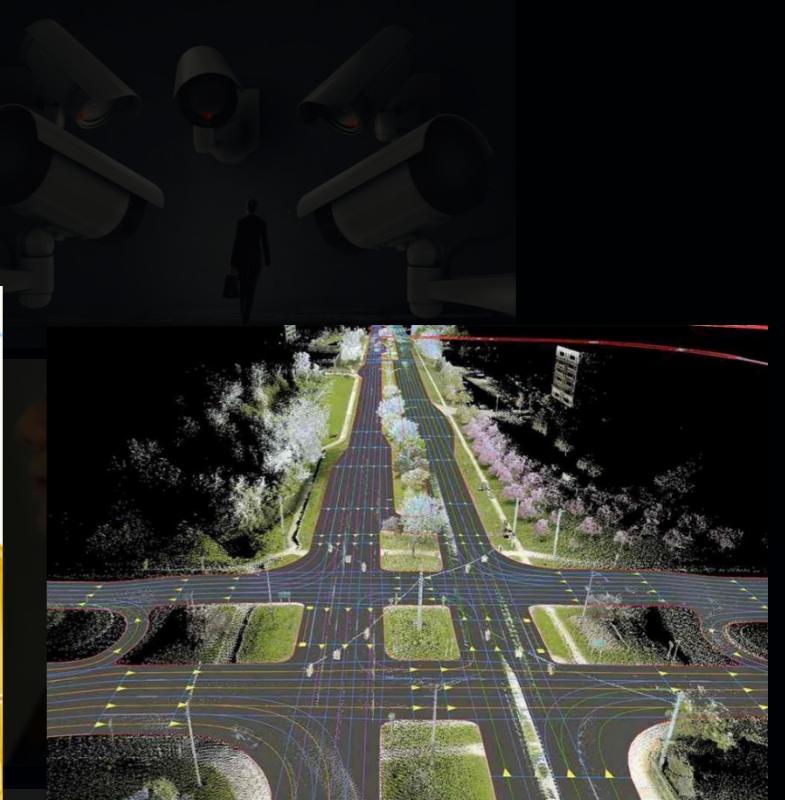
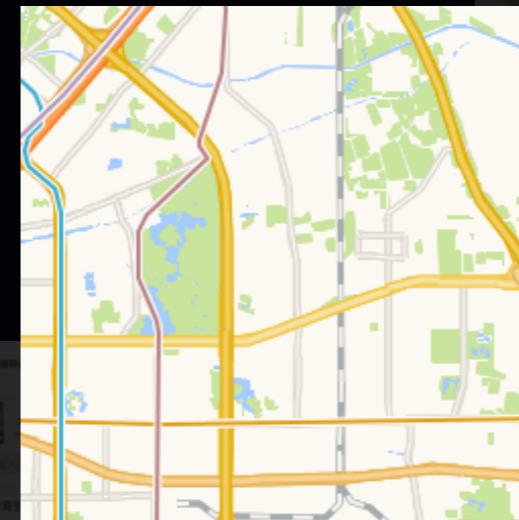
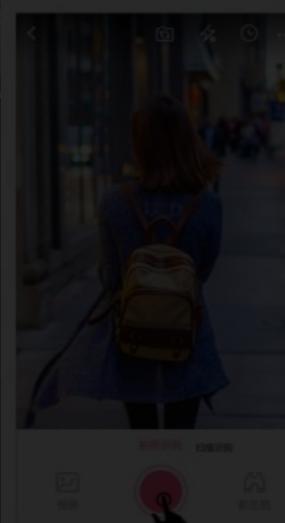
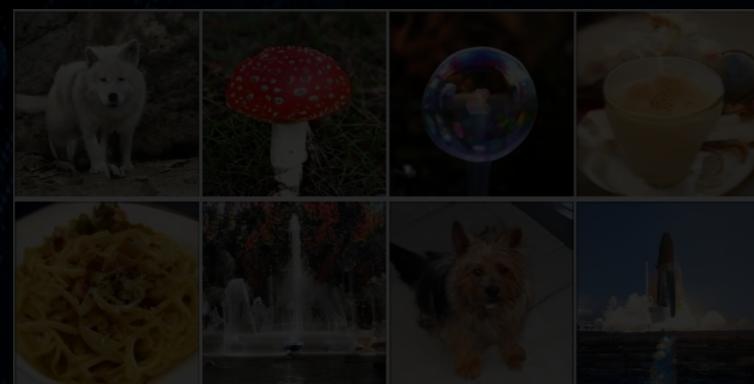
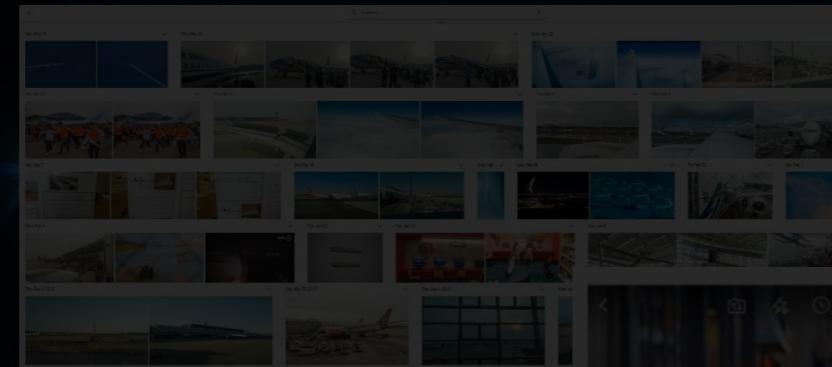
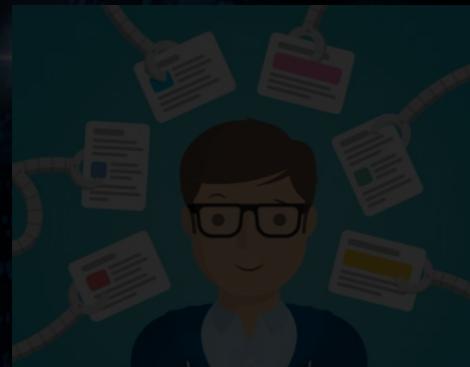
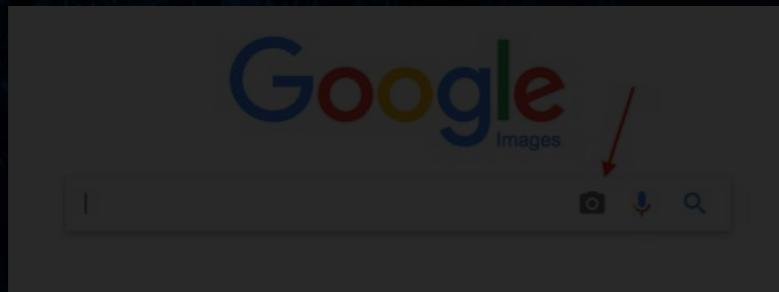


The collage illustrates the intersection of cloud-based computer vision technologies and their real-world applications:

- Surveillance:** Three surveillance cameras mounted on poles, monitoring a person walking away.
- Cloud Interaction:** A woman pointing at a touch screen device displaying a video feed of a person's face.
- Self-Driving Vehicles:** A white self-driving minivan driving on a road under a bridge.
- Amazon Go:** A person in a red shirt walking through a grocery store aisle, with the Amazon Go logo visible.
- Product Recommendation:** A mobile phone screen showing a shopping app interface where a user is viewing a backpack product page, with an orange arrow pointing from the screen towards the physical backpack being held by a person.
- Cloud Search:** A screenshot of the Google Images search interface.

Computer Vision Applications

Cloud | Real World



Thank You

