

Mapping and Navigating in a Hectic World

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Who is Alibaba



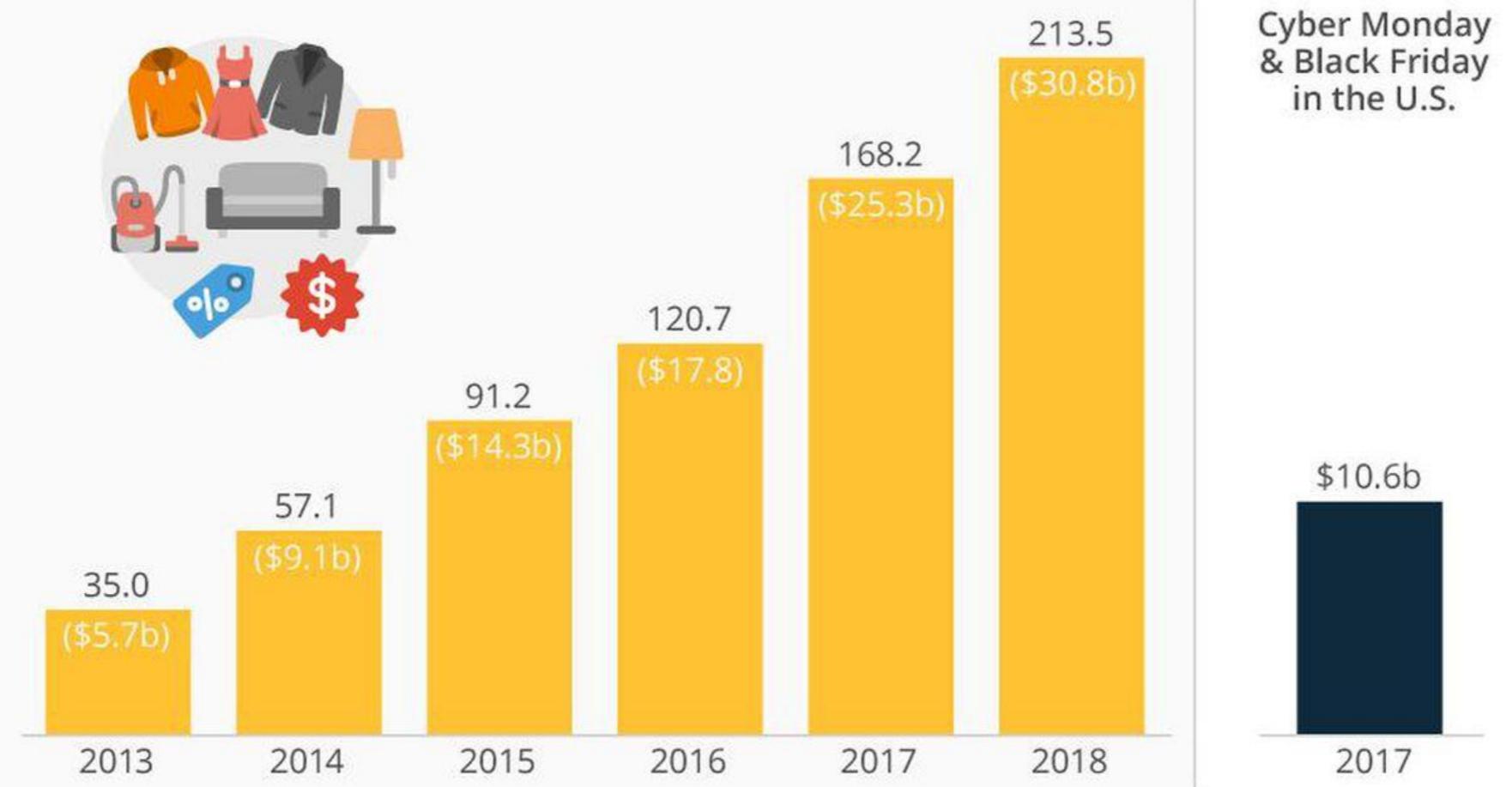
Alibaba @ Hangzhou



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



Digital entertainment



Logistics



E-commerce



Local services



Financial services



Who is Amap (AutoNavi)?

No.1 Mapping and Navigation Company in China



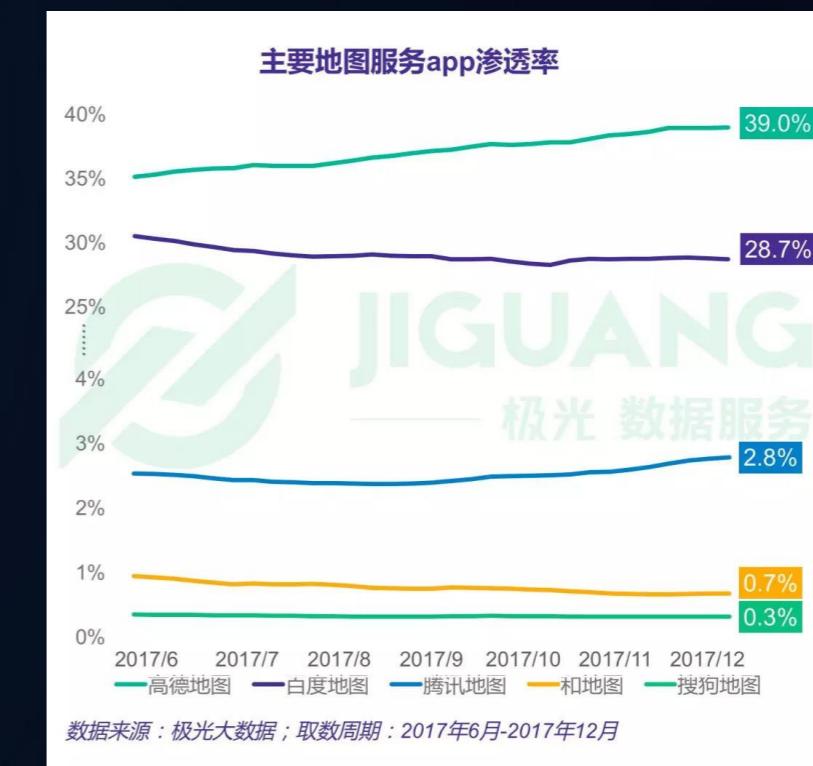
426M active users
(QuestMobile 2018/07)



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
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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



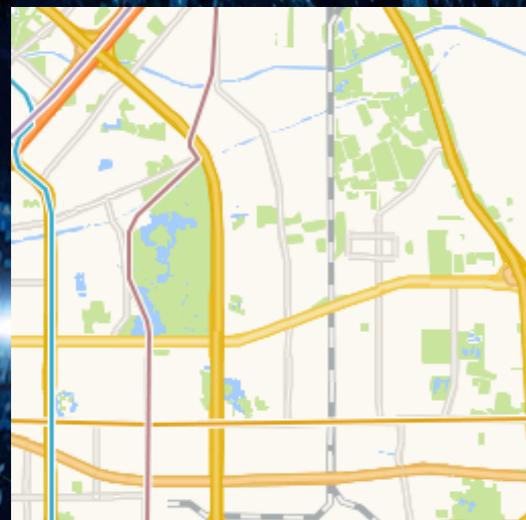
70M POI



..... Upper Body

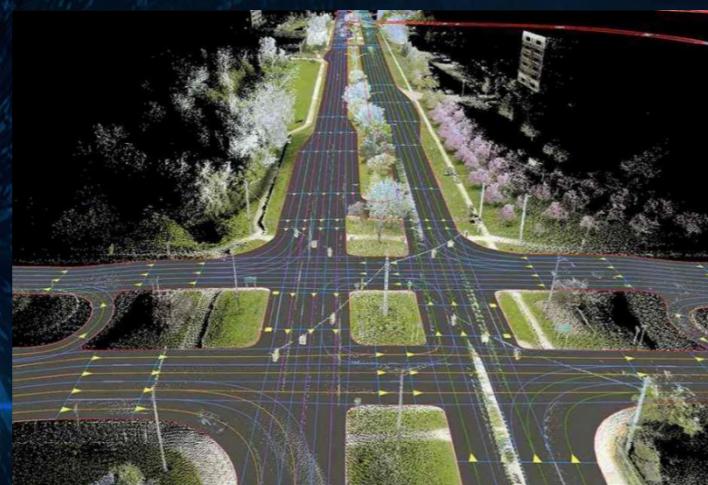
..... Lower Body

Computer Vision @ Amap

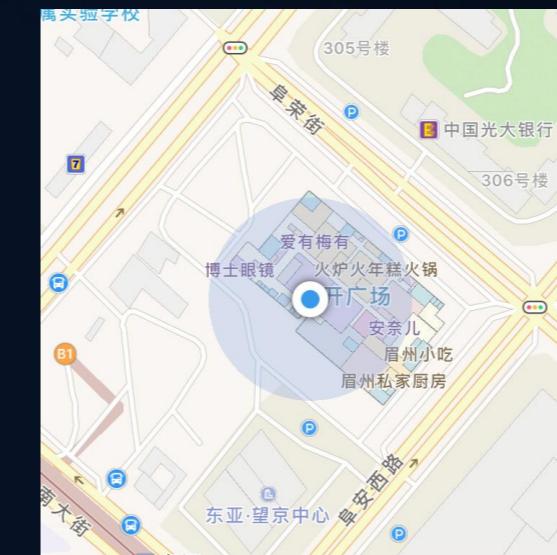


SD Map

Mapping Automation



HD Map



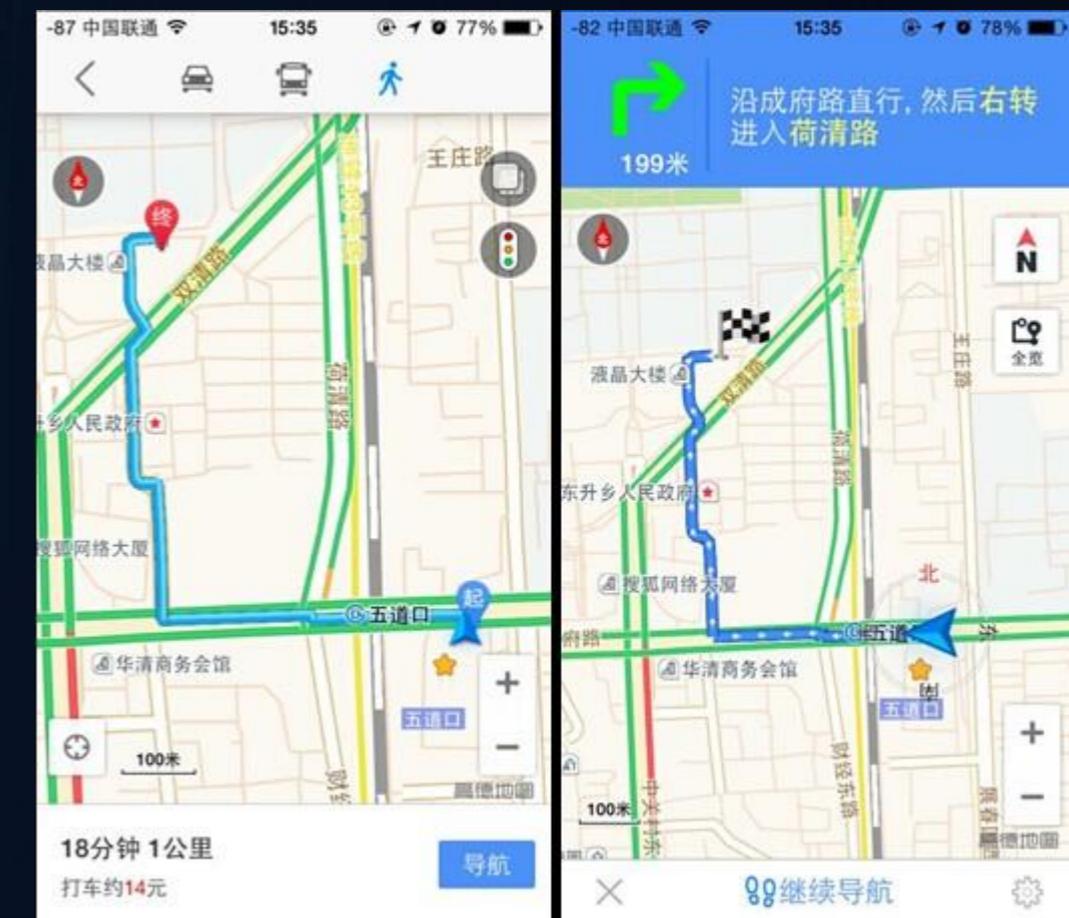
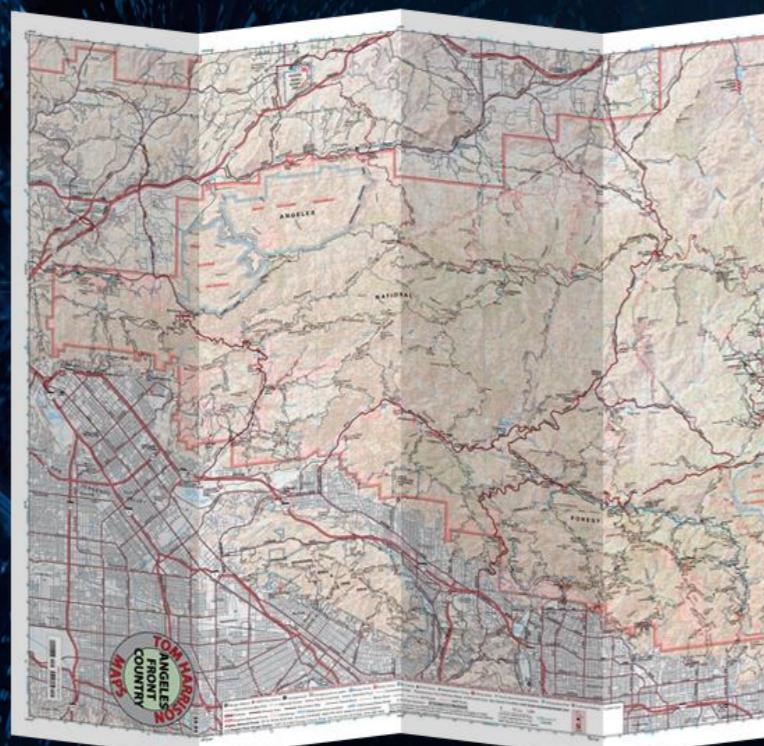
Location

“Easy” Navigation

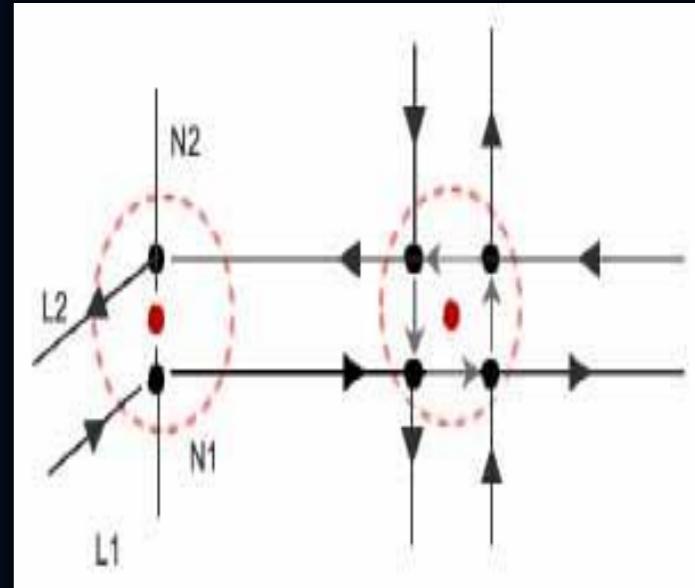
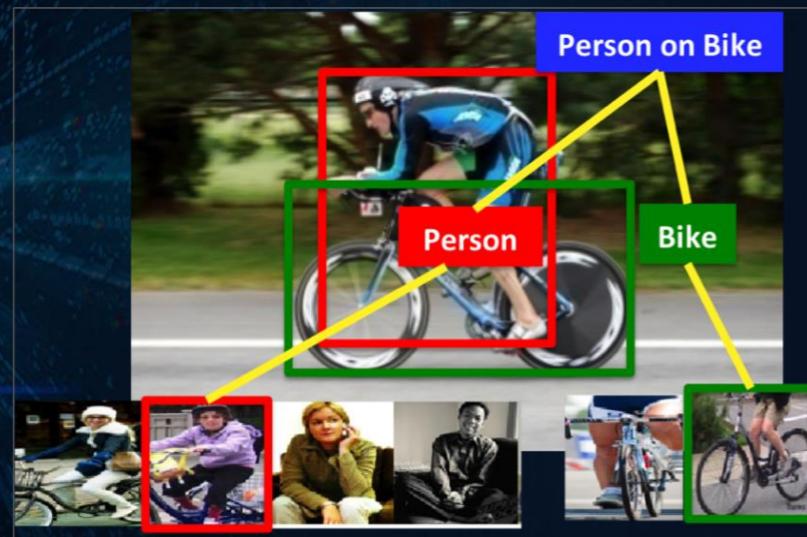


AR Navigation

Under the Hood



Basic Pipeline of Map Production



Data
Acquisition



Automatic
Recognition

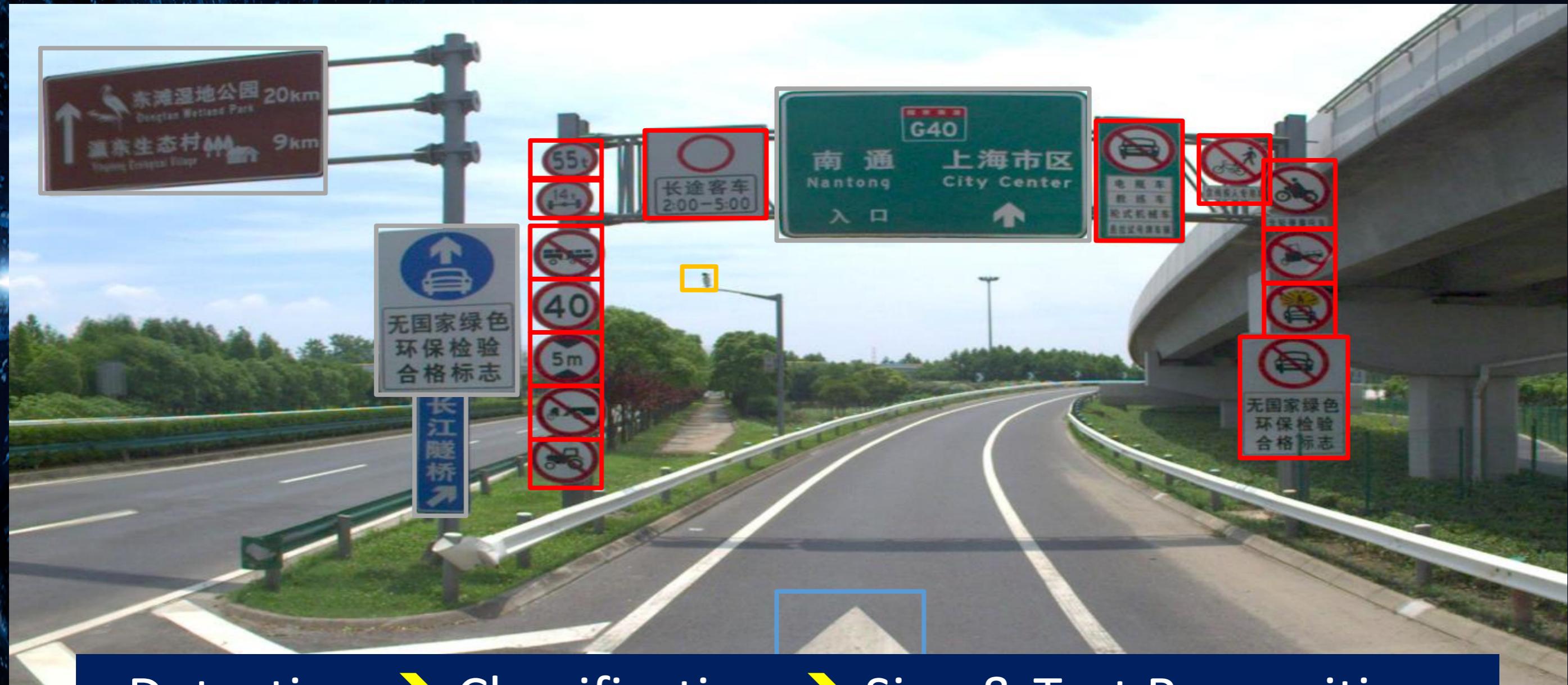


Fusion &
Human Editing



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

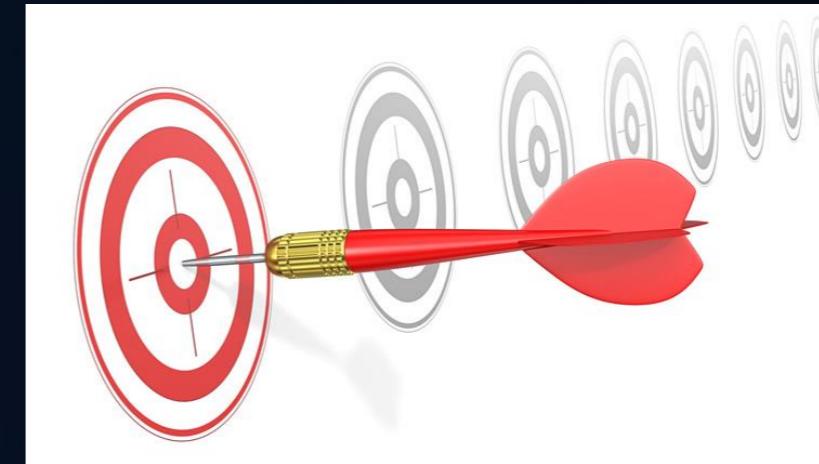
Mapping is a “Deep” Business



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

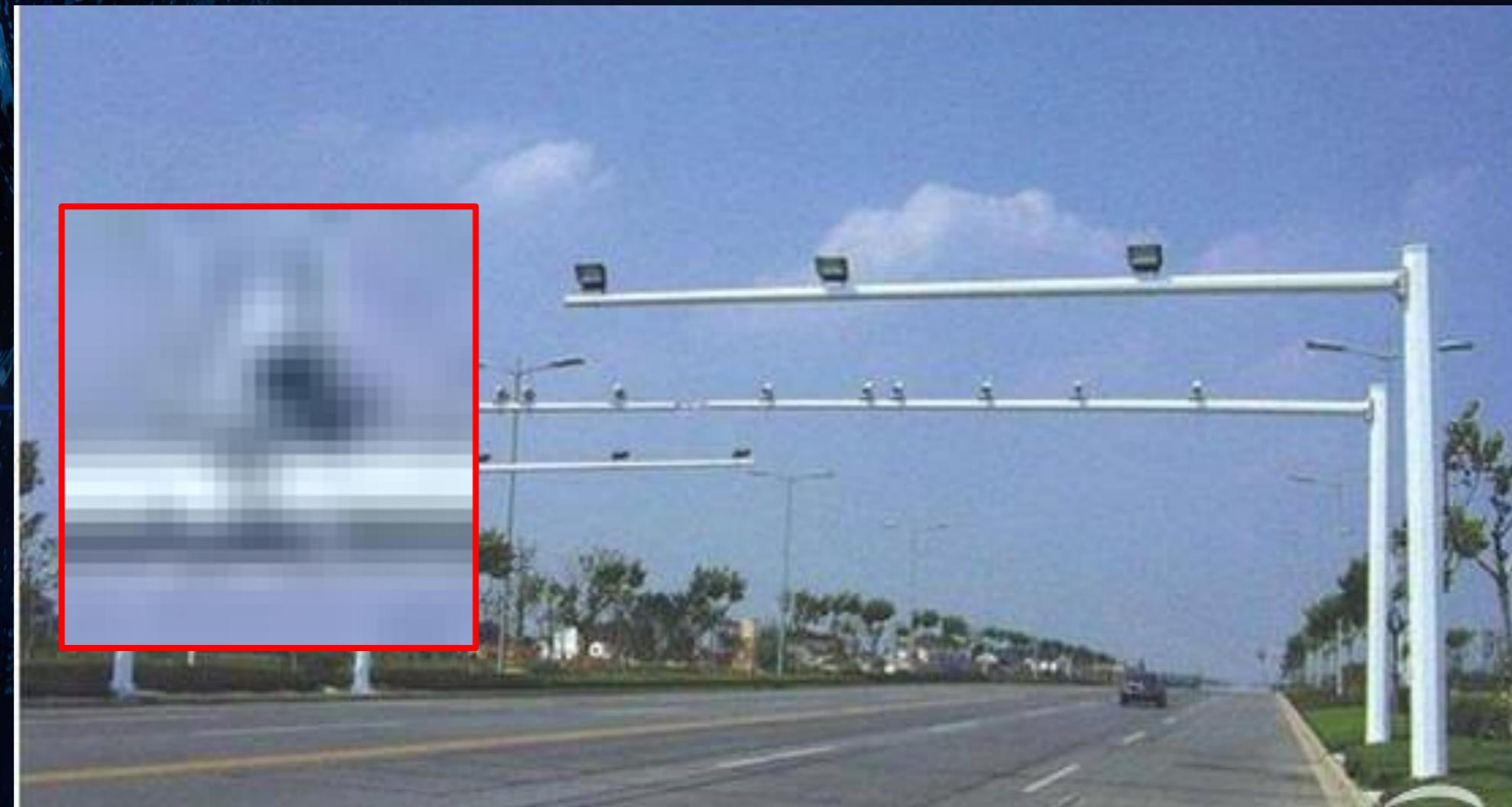
Zoomed

Enhanced

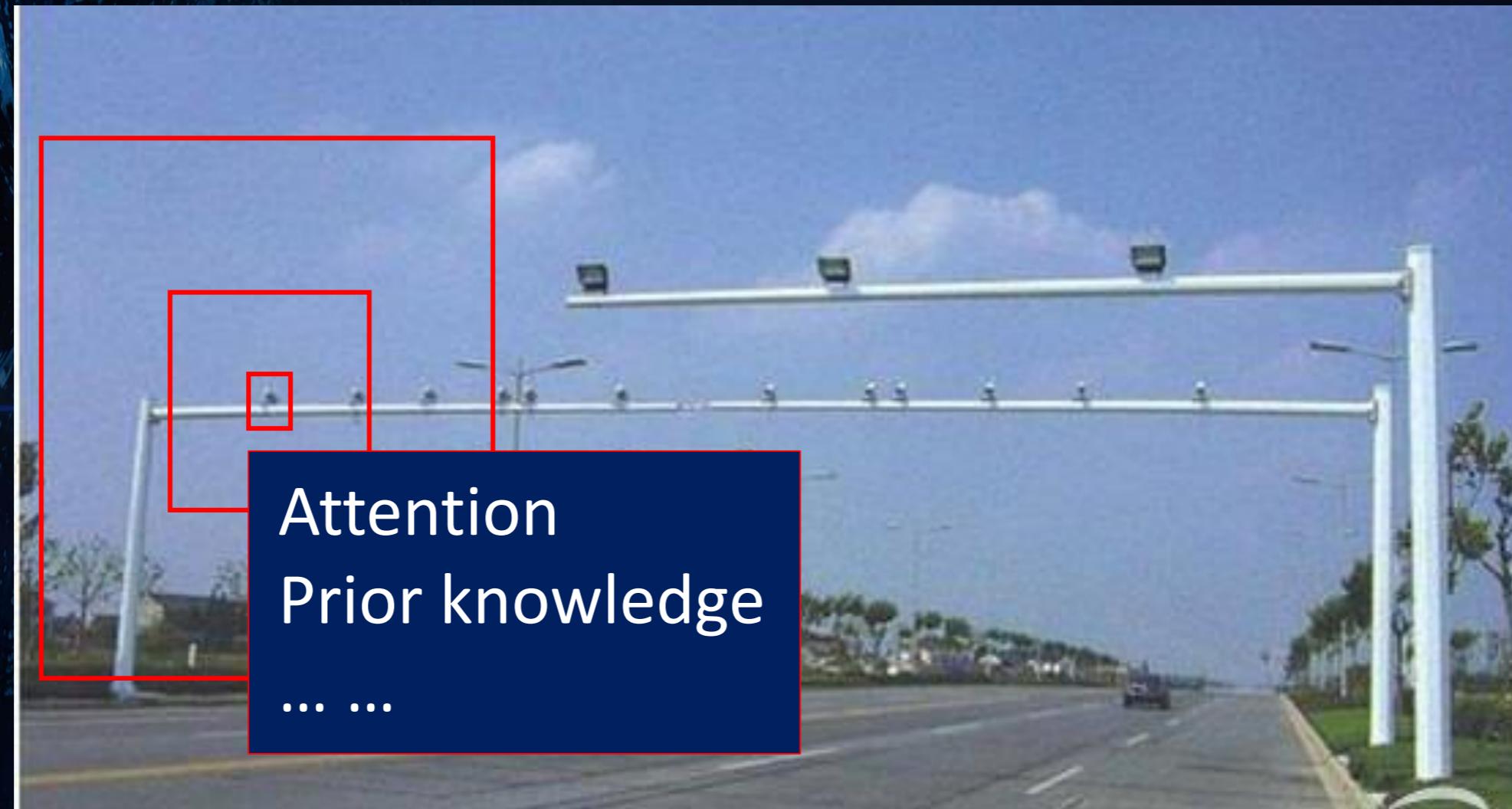
Challenge: Small Objects



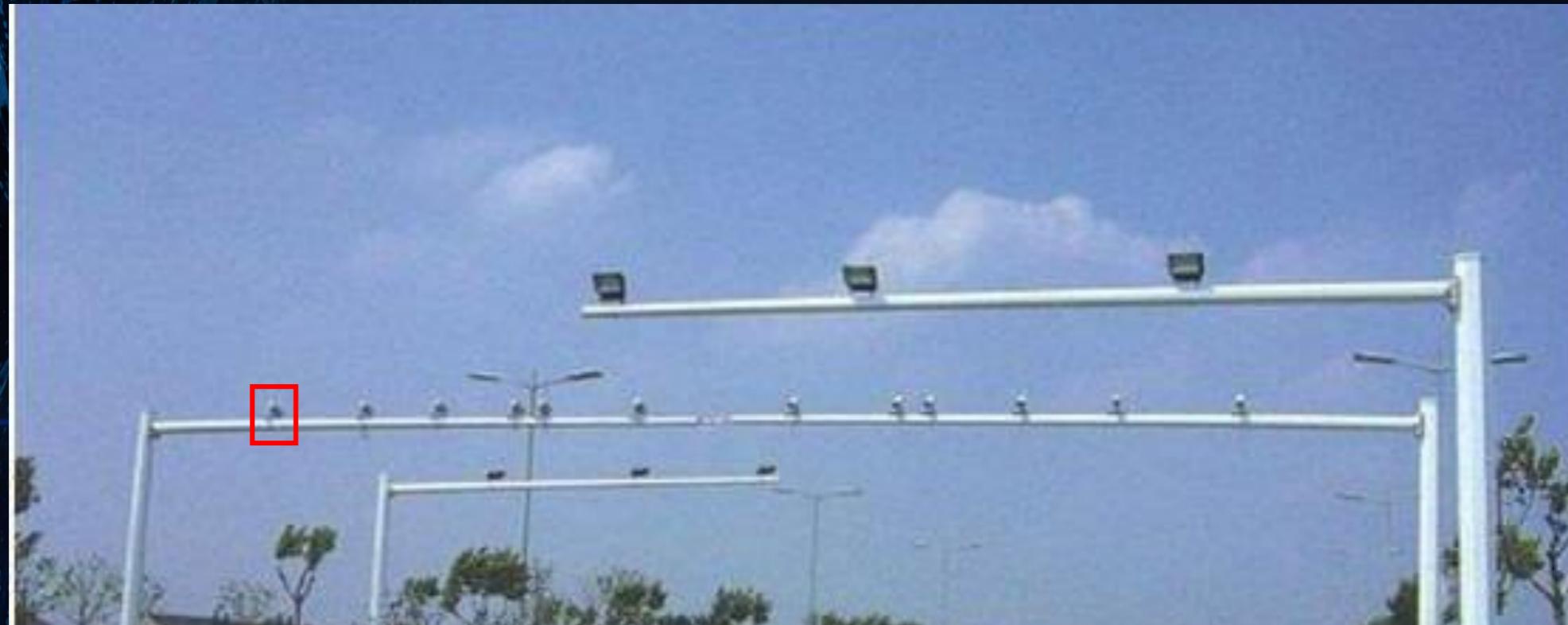
Challenge: Small Objects



Challenge: Small Objects



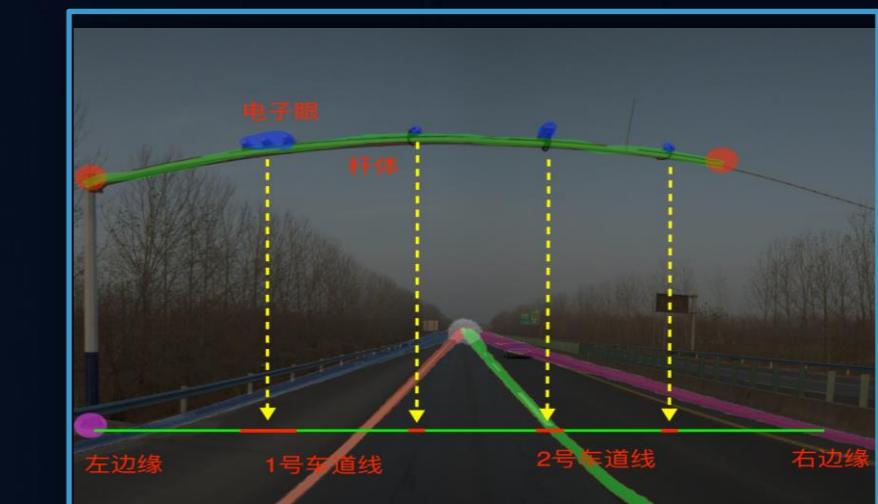
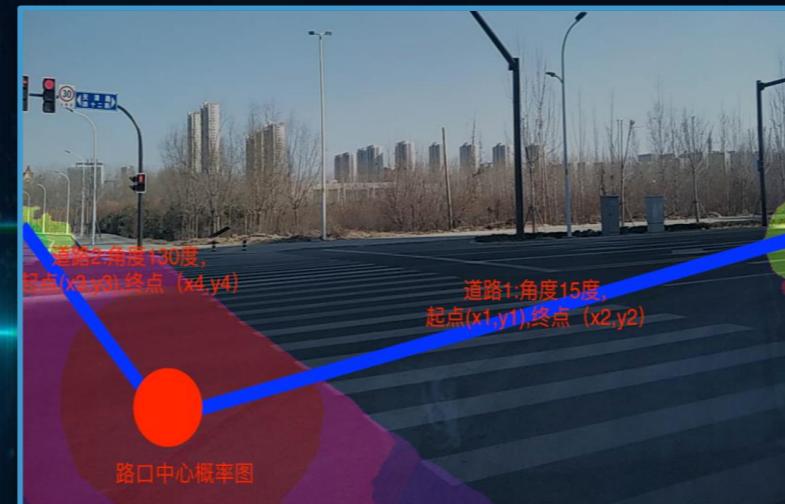
Challenge: Scene Complexity



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

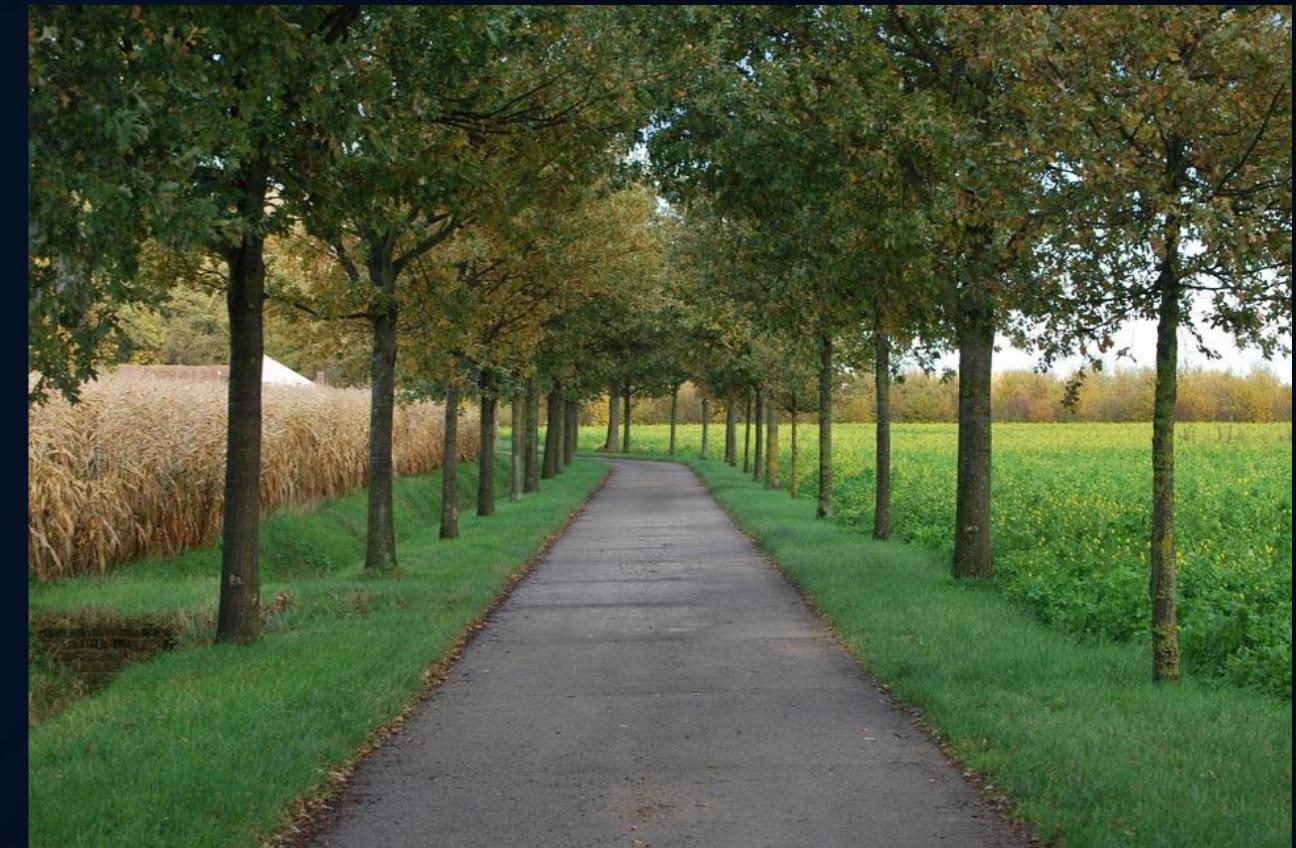


横幅广告

墙体标语

车牌

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?

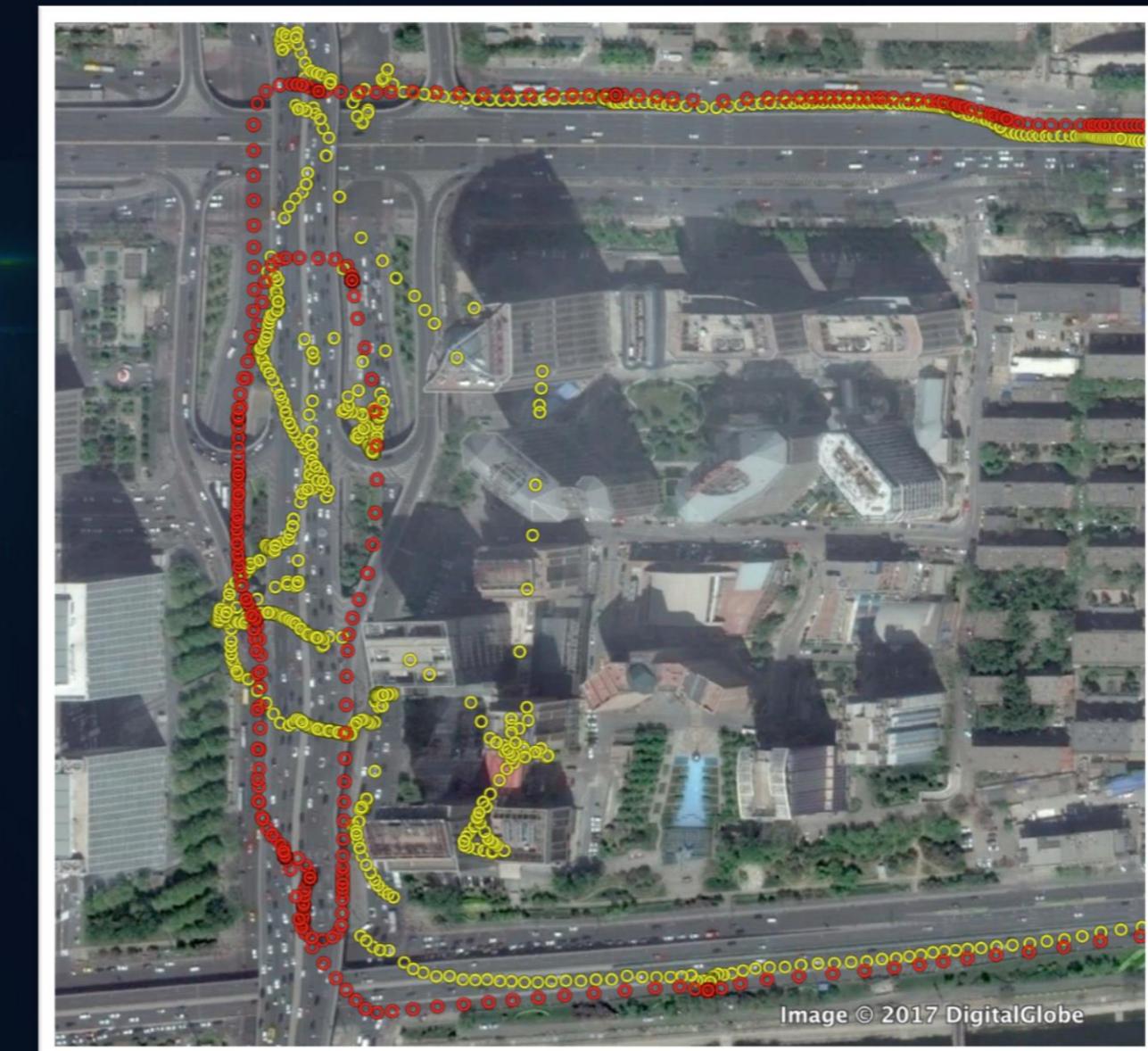
Solution: Vision + GPS



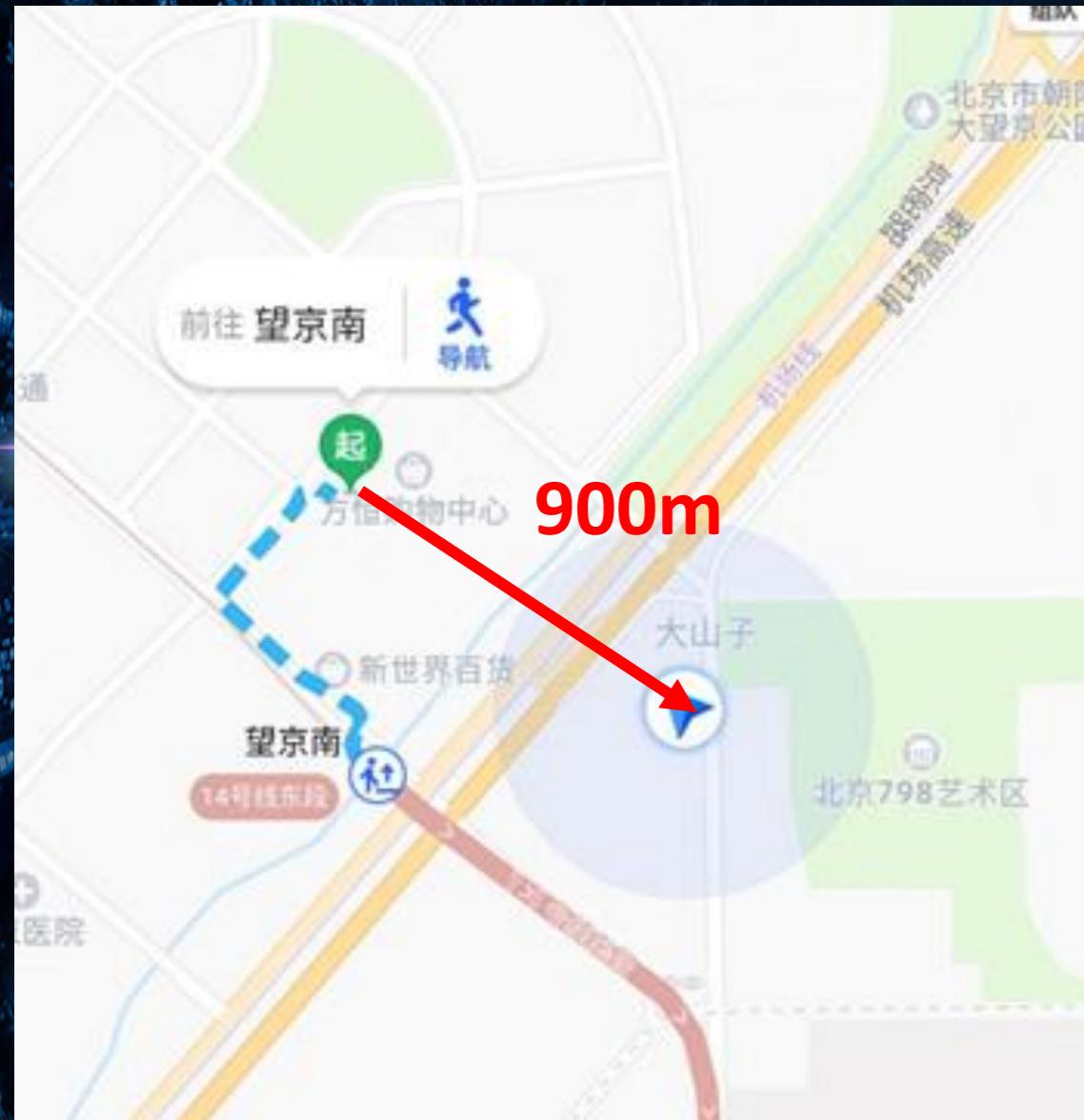
Challenge: Location



Urban Canyon



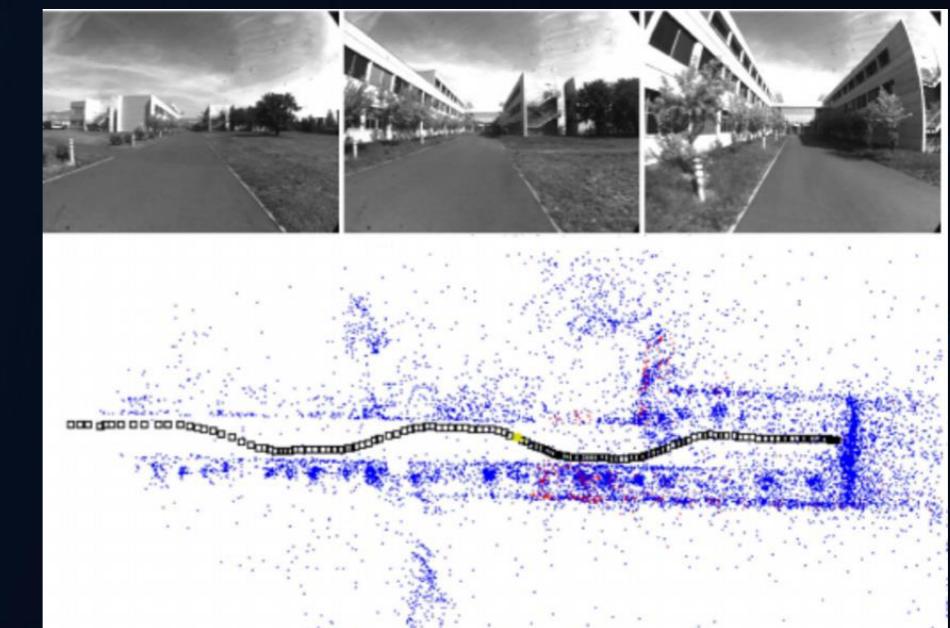
Challenge: Location



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

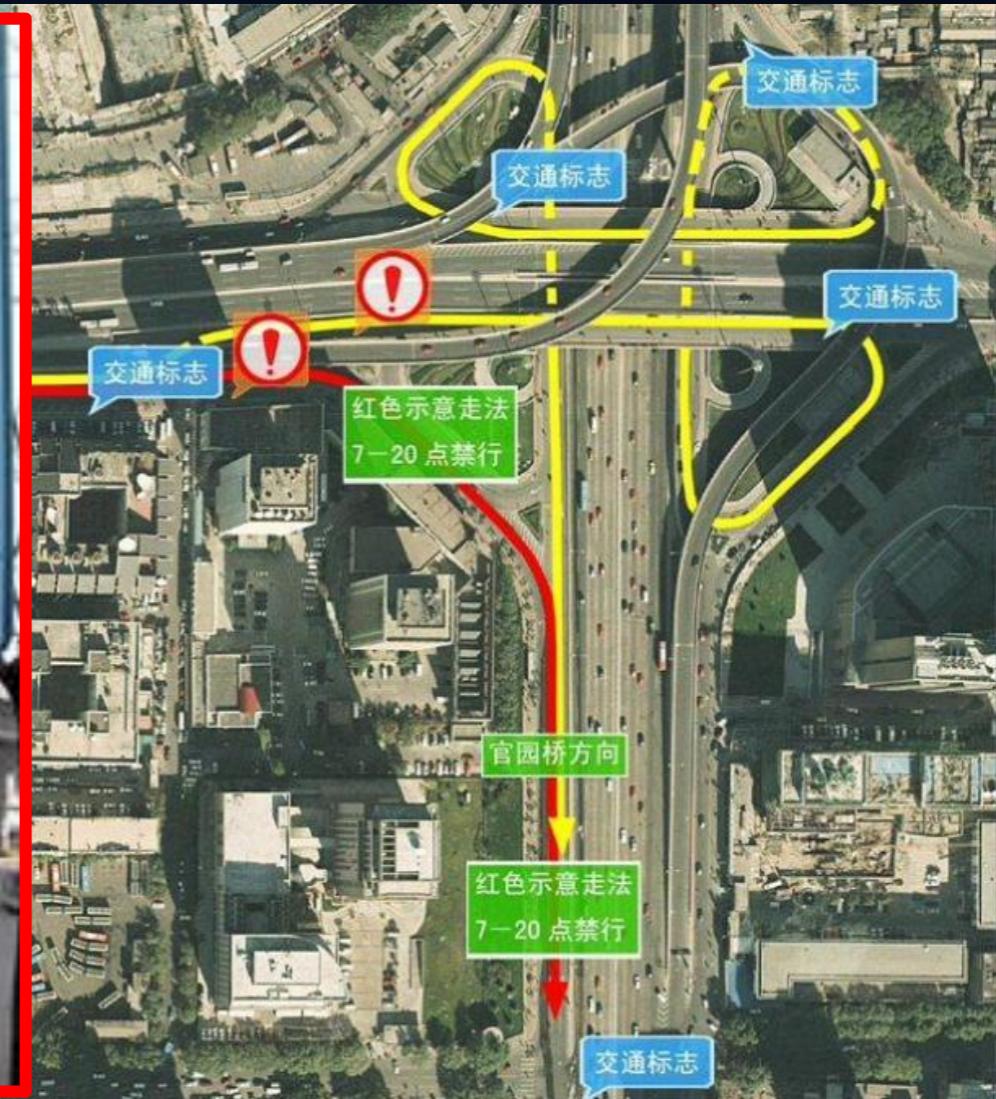
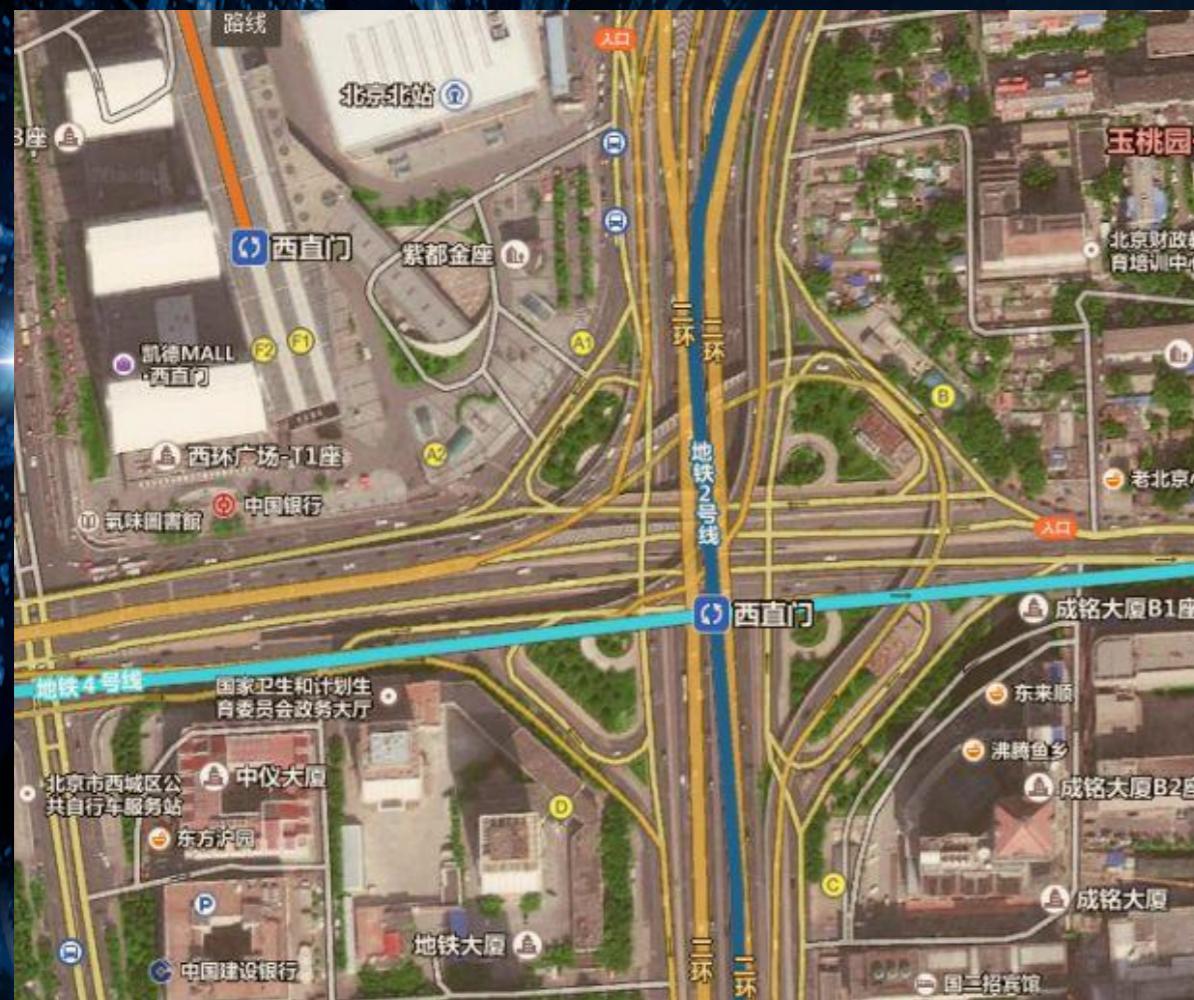
Still, Reality Can Beat You



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



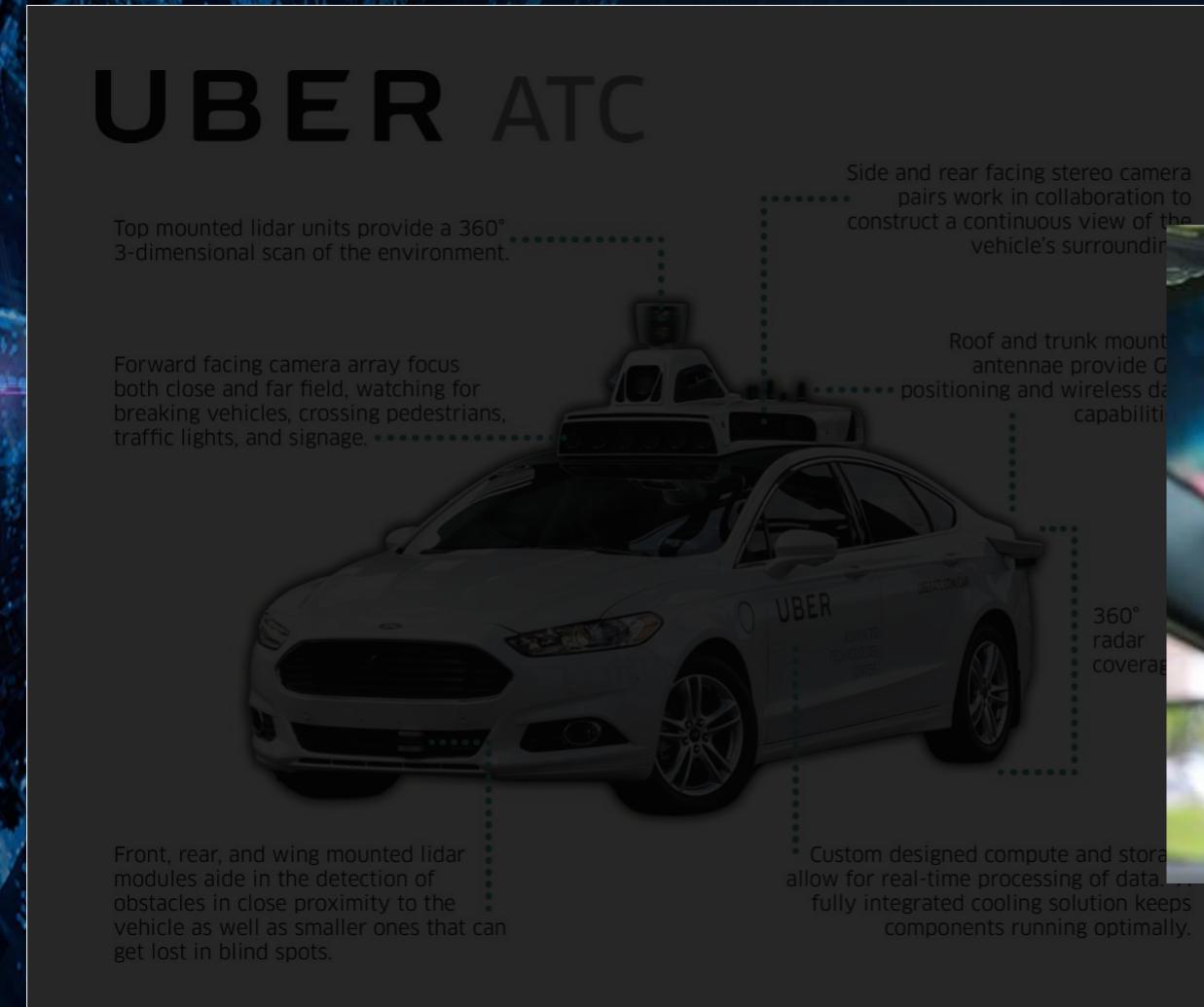
Launched April 2019

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



Top mounted lidar units provide a 360° 3-dimensional scan of the environment.

Forward facing camera array focus both close and far field, watching for breaking vehicles, crossing pedestrians, traffic lights, and signage.

Front, rear, and wing mounted lidar modules aide 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.

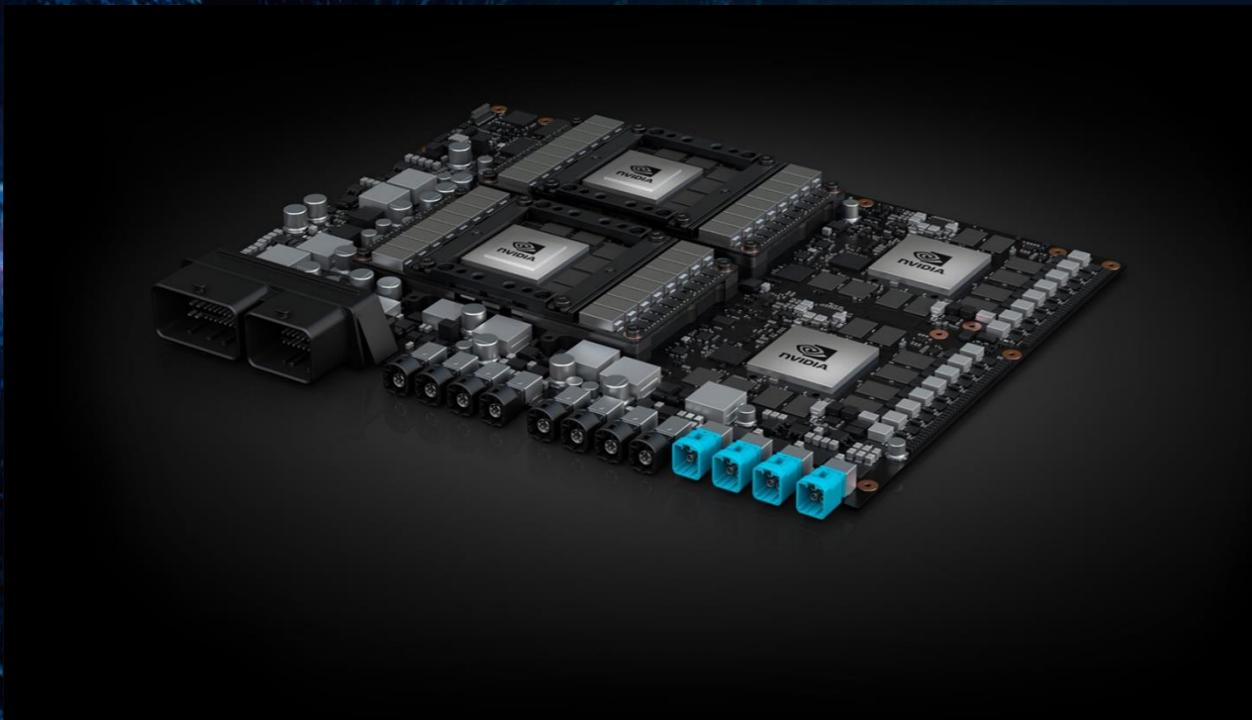
Roof and trunk mount antennae provide GPS positioning and wireless data capabilities.

360° radar coverage.

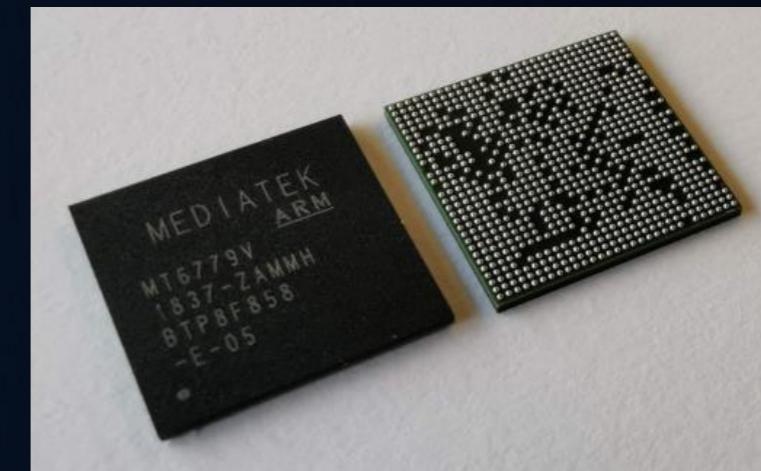
Custom designed compute and storage allow for real-time processing of data... fully integrated cooling solution keeps components running optimally.



Challenge: Minimal Compute

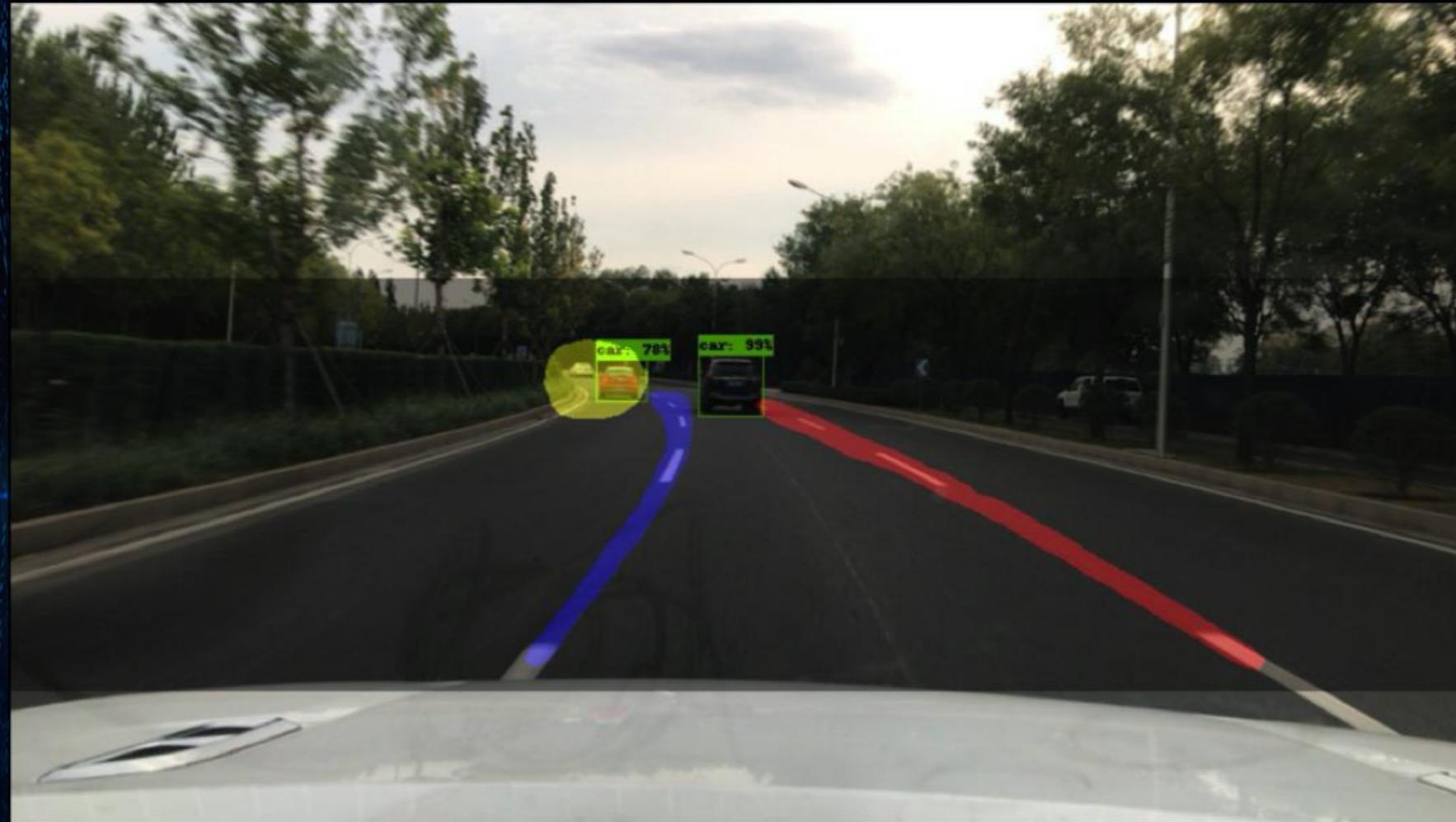


Nvidia DRIVE AGX



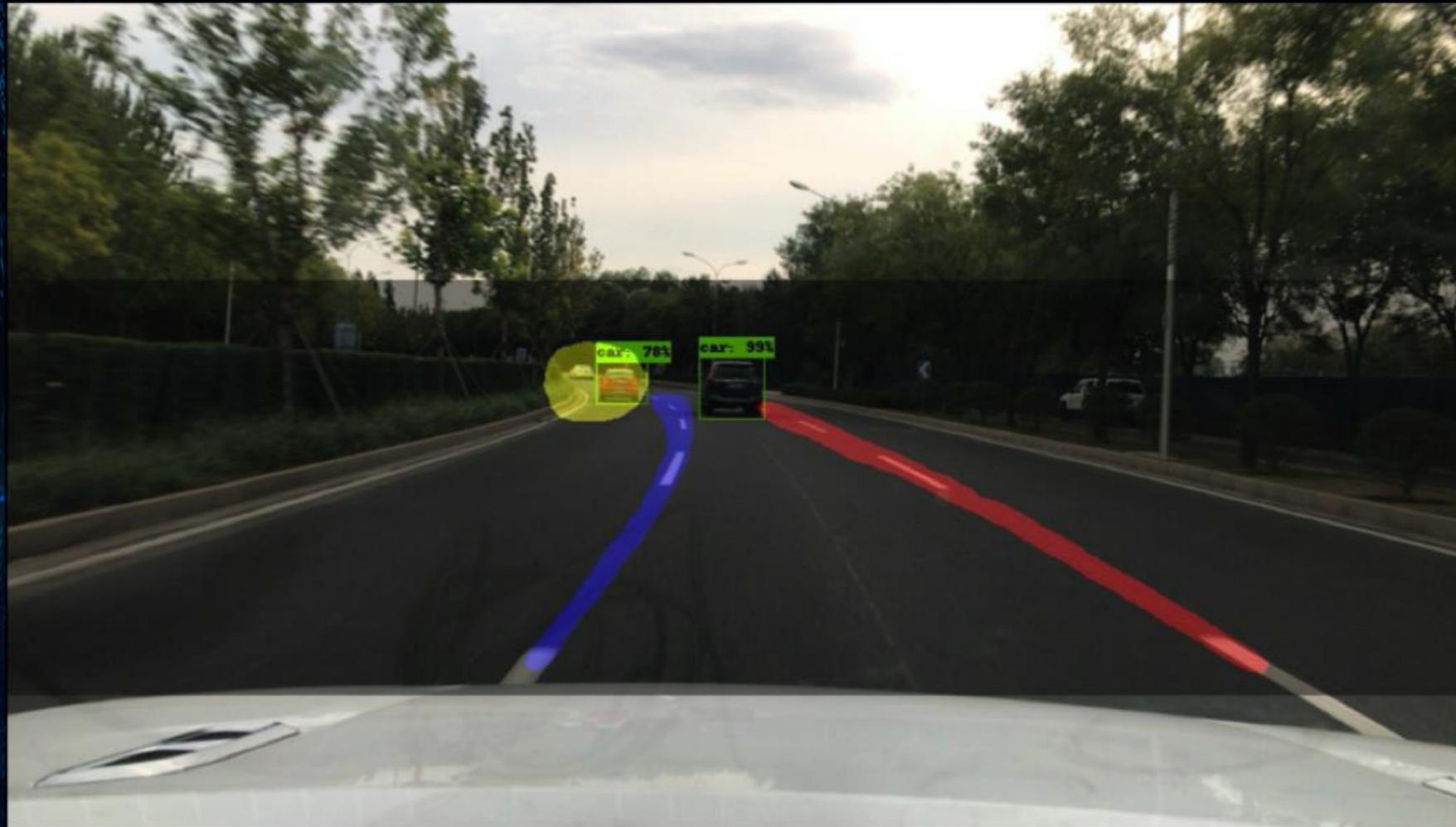
MTK8783

AR Navigation: Car Detection



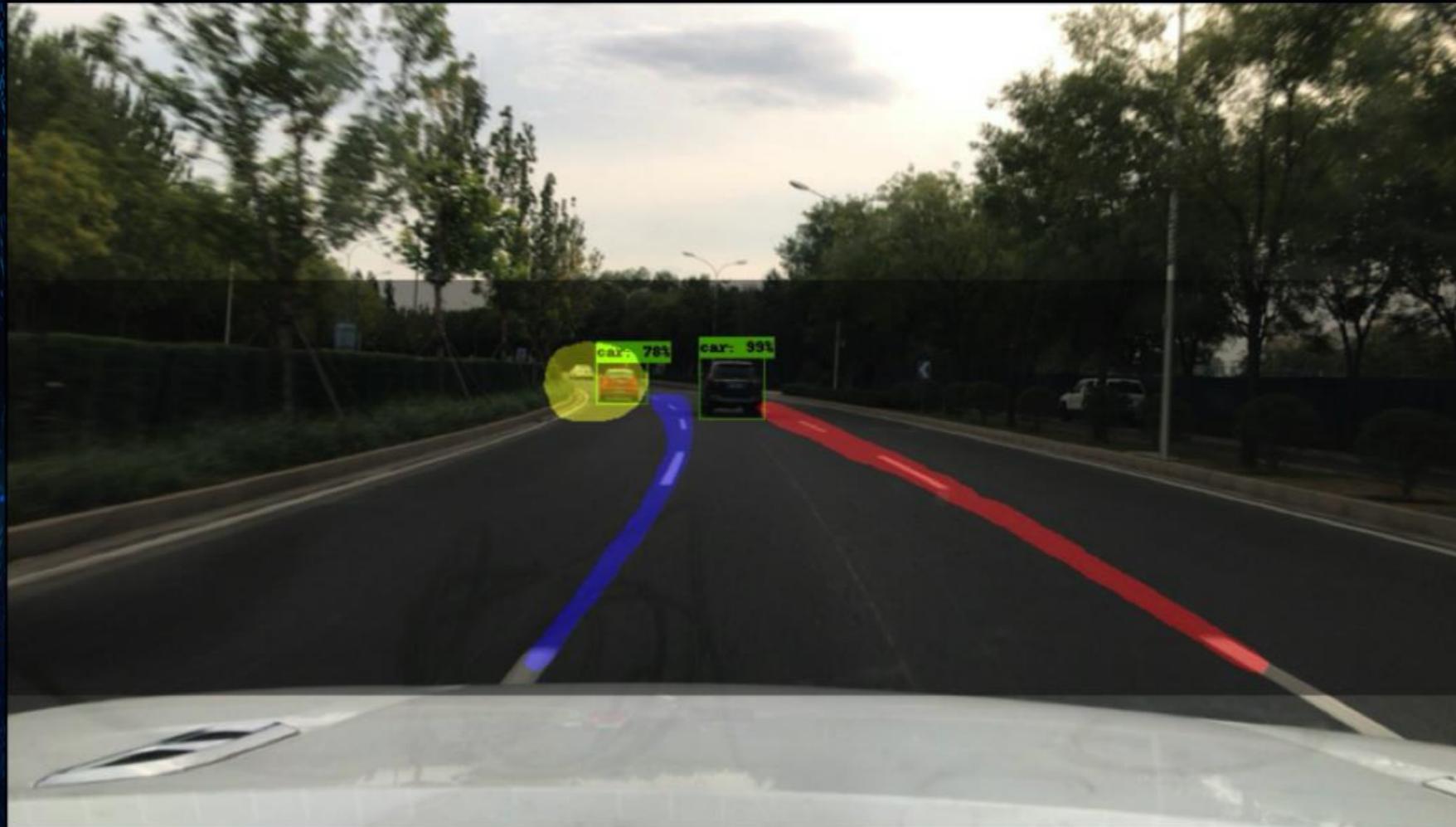
(1) model compression (2) utilize scale (3) combine with tracking

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

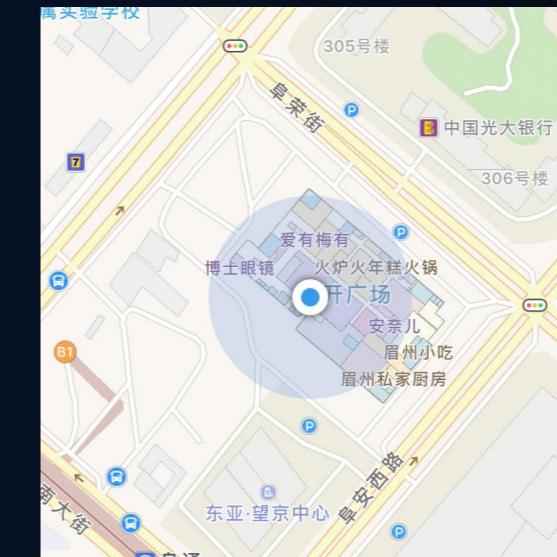
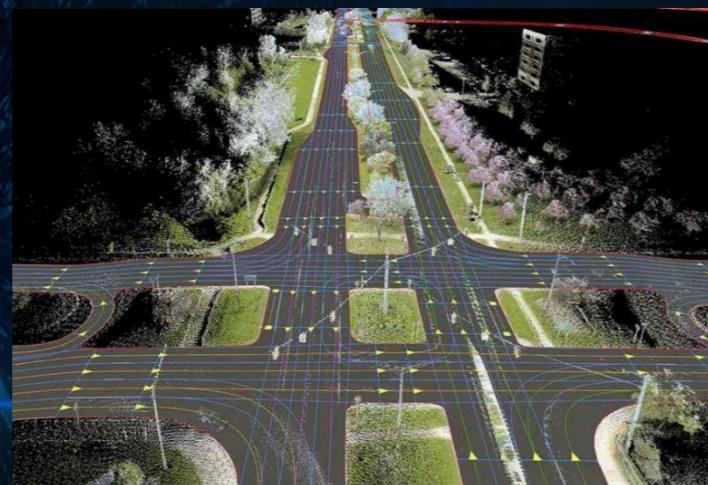
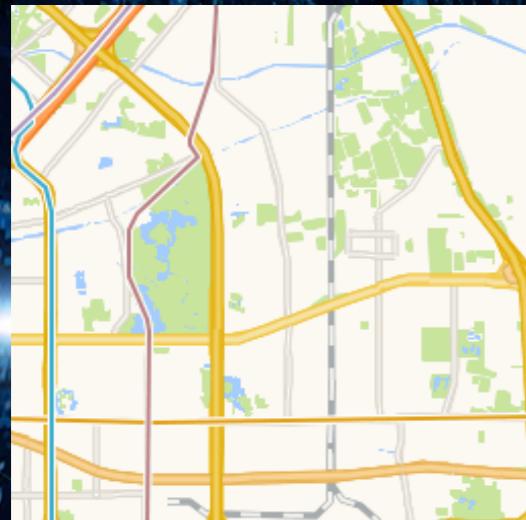
AR Navigation: Compute



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

HD Map

Mapping Automation

Location

AR Navigation

“Easy” Navigation

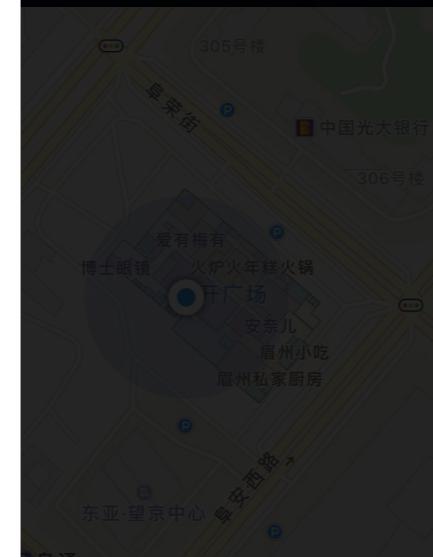
Computer Vision @ Amap

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

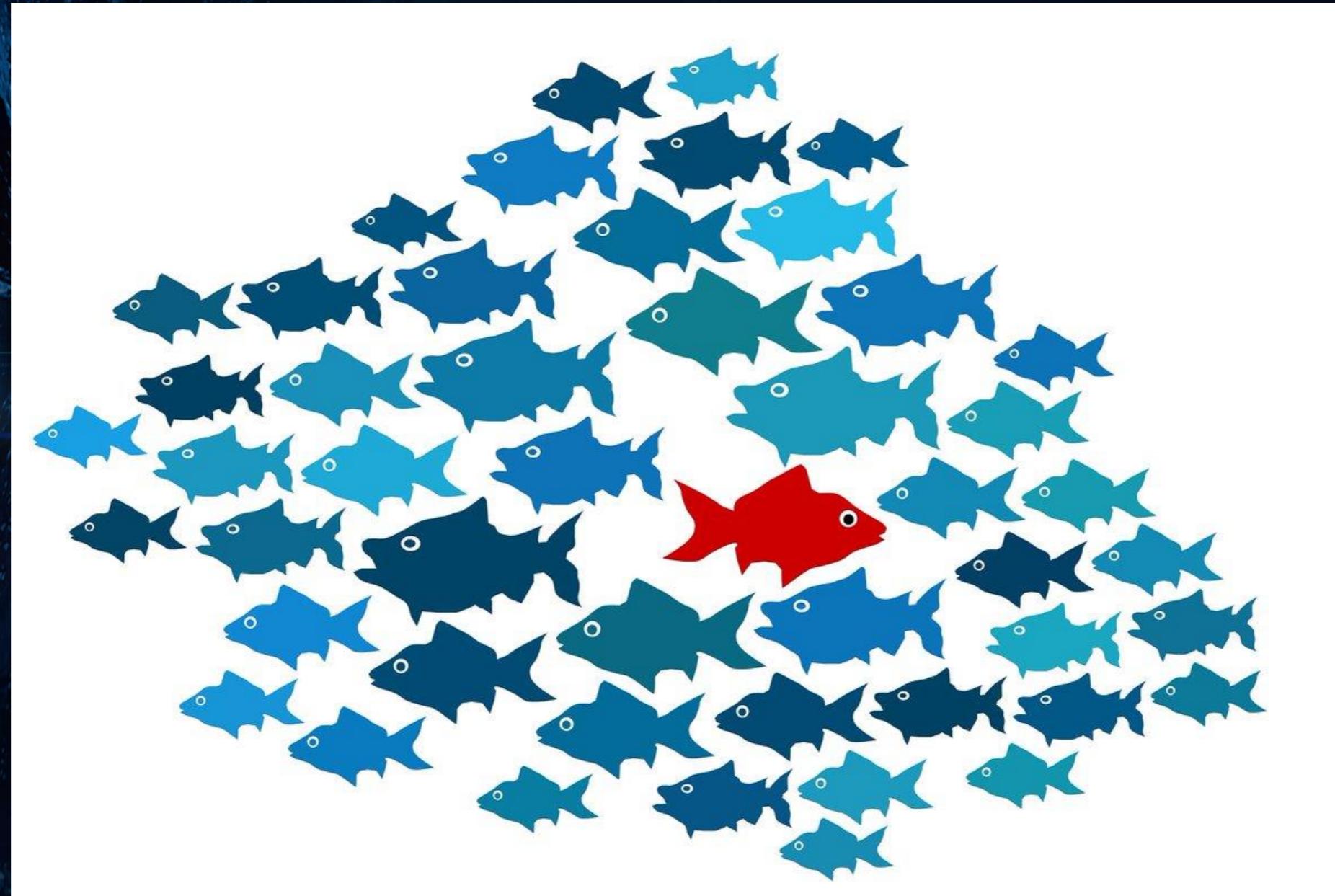


People driving cars



Machine driving cars

The Future of Mapping and Navigation

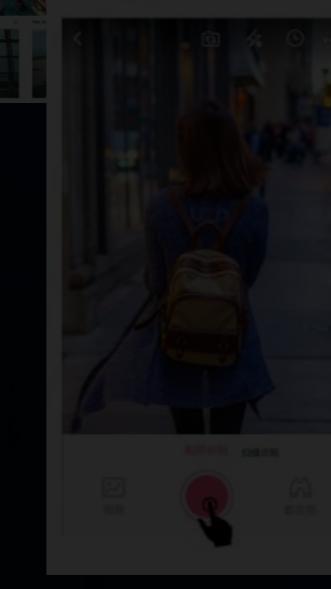
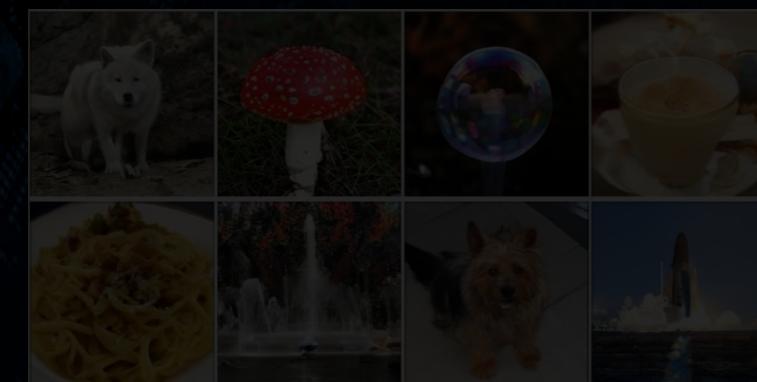
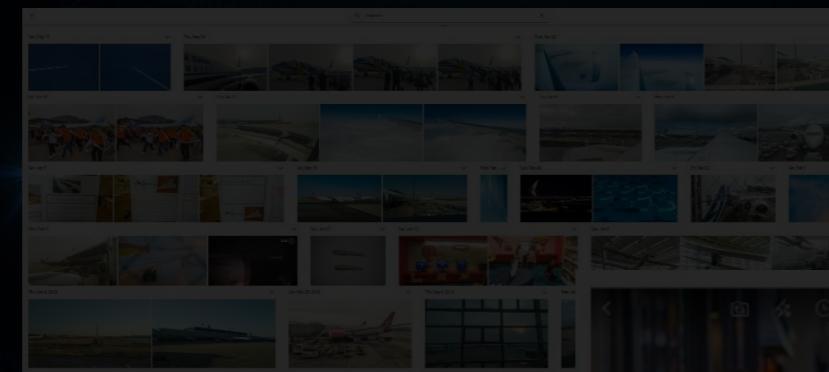
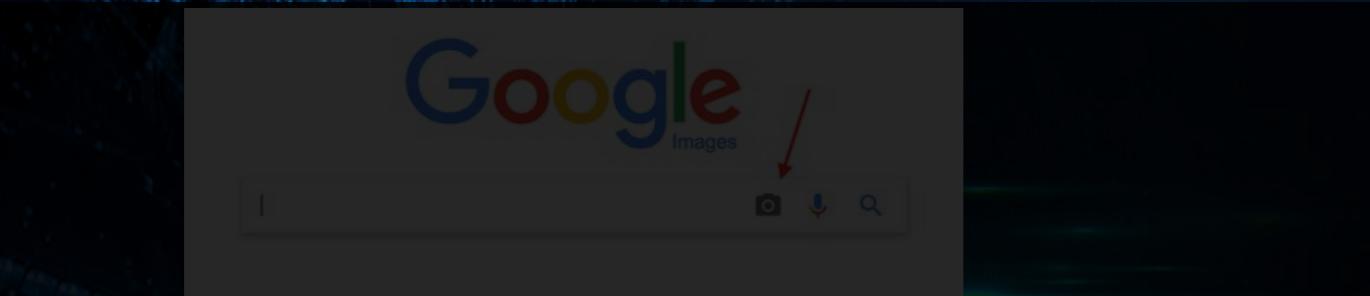




连接真实世界 让出行更美好

Computer Vision Applications

Cloud | Real World

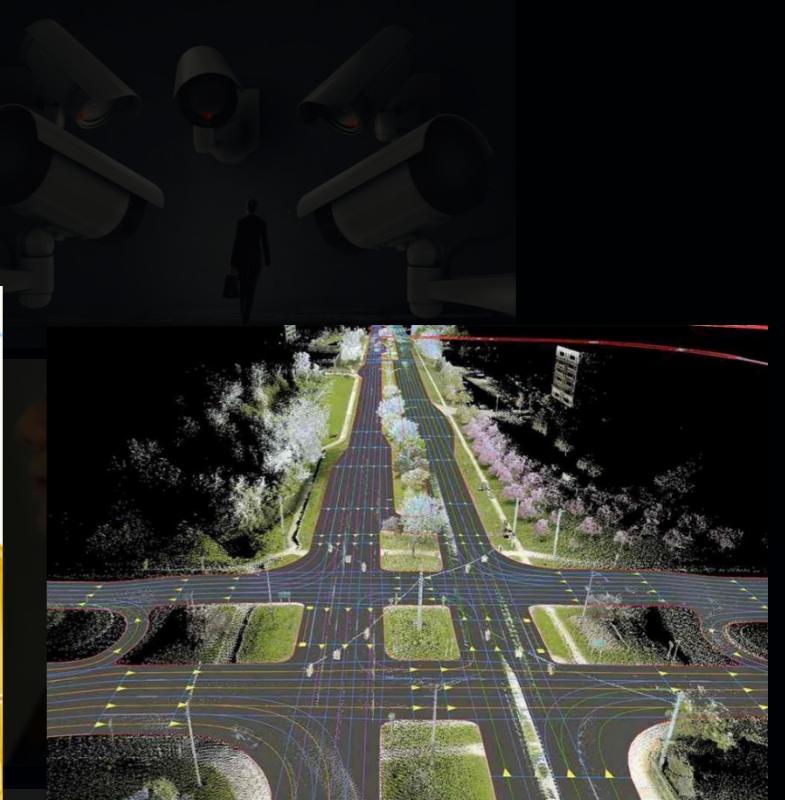
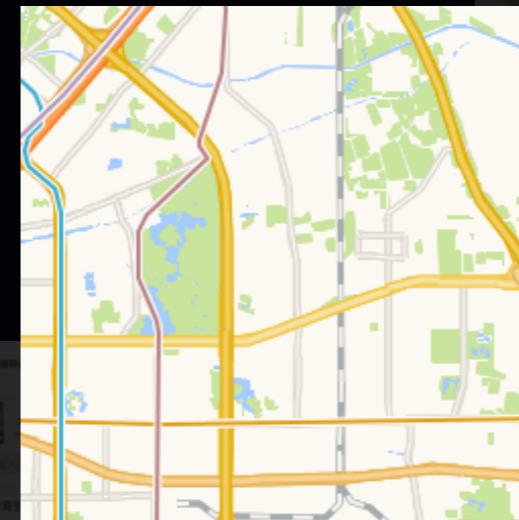
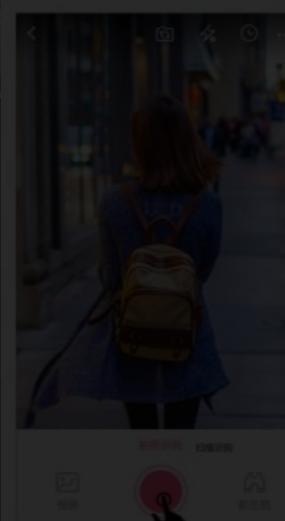
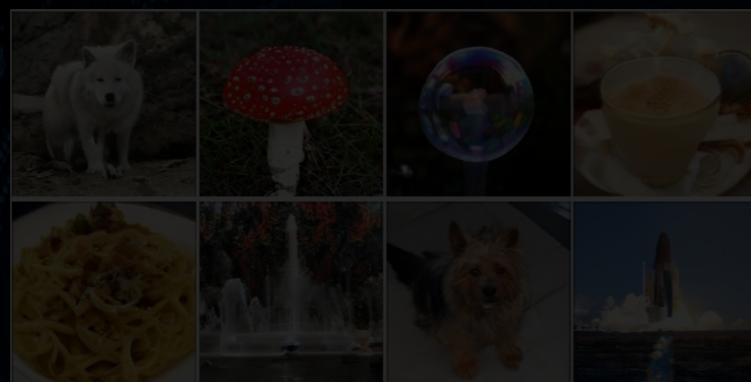
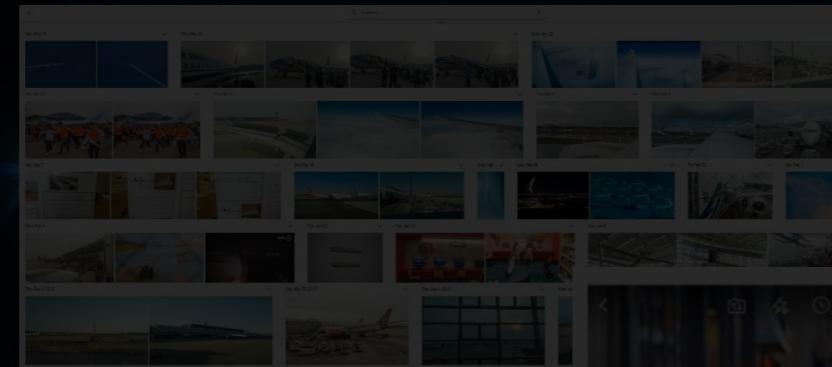
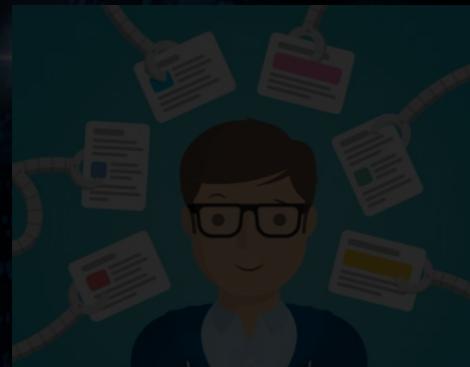
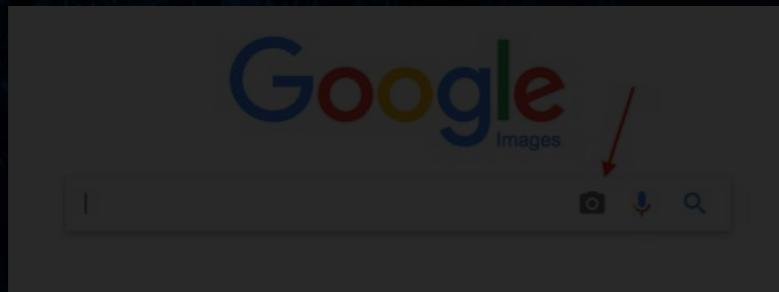


The collage illustrates several real-world applications of computer vision:

- Surveillance: Three surveillance cameras mounted on poles, monitoring a person walking away.
- Human-computer interaction: A woman interacting with a touch screen device, possibly a kiosk or a smartphone.
- Autonomous driving: A white self-driving car (Waymo) driving on a road under an overpass.
- Amazon Go: A person shopping in a grocery store aisle where products are tracked without traditional checkout lines.
- Cloud storage: A screenshot of the Google Images search interface.
- Data management: An illustration of a person surrounded by documents and files.
- Image search: A grid of numerous small images, representing a large dataset or search results.
- Product recognition: A woman using a smartphone to scan a product, with a digital overlay showing price information (¥0.01).
- Cloud storage interface: A screenshot of a cloud storage application showing a list of files and folders.

Computer Vision Applications

Cloud | Real World



Thank You

