Self-Driving Cars

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Background

Beginning

- Started in luxury vehicles
  - Cameras
  - Automatic braking
- ADAS (advanced driver-assistance systems) rose from 90 million in 2014 to 140 million in 2016

Problems

- People rely on them too much
- Likely won't decrease automobile fatalities
- Validating Systems would likely take years

Levels of automation

- Level 0 refers to no driving automation
- Level 1 refers to some driver assistance
- Level 2 refers to partial driving automation
- Level 3 refers to conditional driving automation
- Level 4 refers to high driving automation
- Level 5 refers to full driving automation

We will be focusing mostly on levels 4 and 5 since those are the more complicated versions and are farther away.

How far away are self-driving cars?

- Over a decade away
  - Problem is development of software
- Cameras face difficulty in extreme weather conditions
- Software development stalled due to high complexity and breadth of research

Three Main Problems

Overreliance

People would rely on the technology too much, which may result in an increase in injuries.

Automobile Deaths

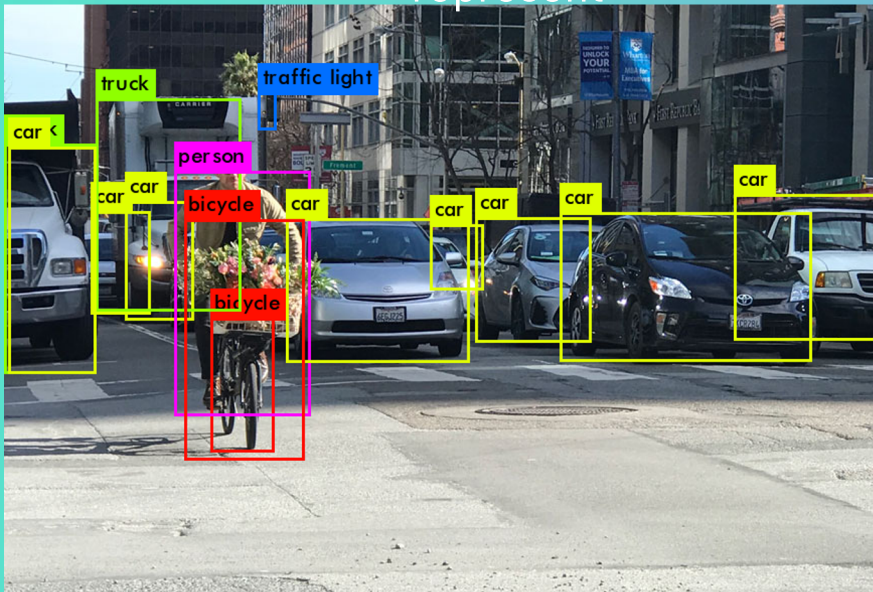Experts predict that large scale automobile automation would likely not decrease automobile deaths/accidents.

Validation

Validating autonomous automobiles for safety would take years

Object Analysis

Purpose
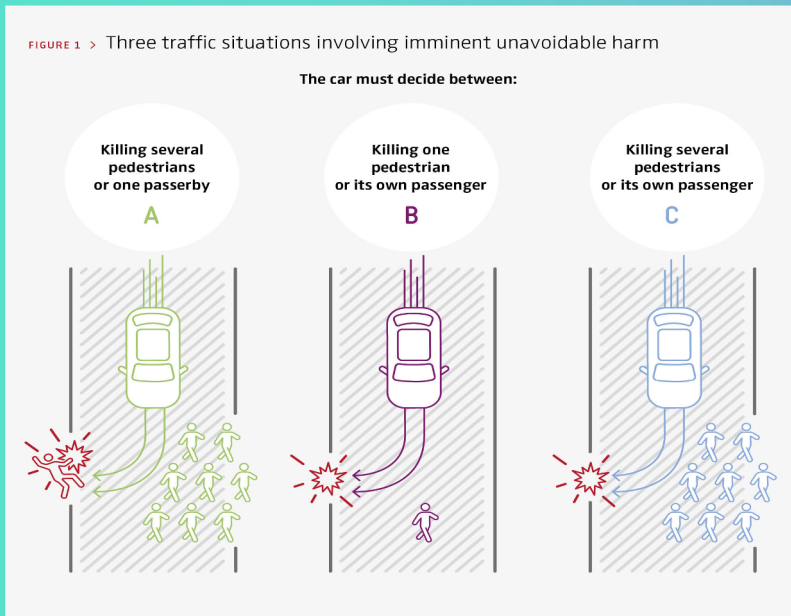Detects objects and understands what they represent

Challenges
- Sensor fusion required for object analysis is technically challenging
- Object detection is the main issue - many different factors

Decision-Making Systems

Purpose
To mimic human decision making

FIGURE 1 > Three traffic situations involving imminent unavoidable harm

The car must decide between:

Killing several pedestrians or one passerby
A

Killing one pedestrian or its own passenger
B

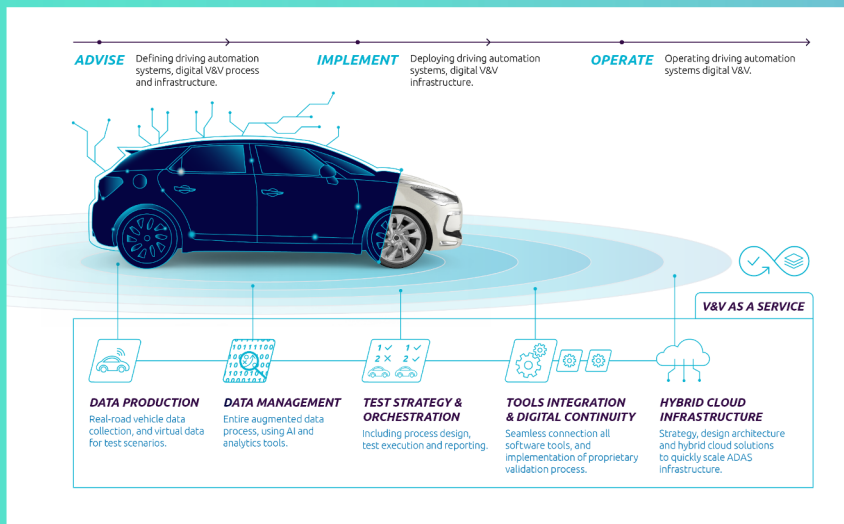Killing several pedestrians or its own passenger
C

Challenges

- Requires comprehensive training and understand scenarios
- Can't use if-then
- Must create an AI that can make smart inferences and use those to make its own decisions

Validation

Purpose
To ensure autonomous automobiles are safe for use

ADVISE — Defining driving automation systems, digital V&V process and infrastructure.

IMPLEMENT — Deploying driving automation systems, digital V&V infrastructure.

OPERATE — Operating driving automation systems digital V&V.

V&V AS A SERVICE

DATA PRODUCTION — Real-road vehicle data collection, and virtual data for test scenarios.

DATA MANAGEMENT — Entire augmented data process, using AI and analytics tools.

TEST STRATEGY & ORCHESTRATION — Including process design, test execution and reporting.

TOOLS INTEGRATION & DIGITAL CONTINUITY — Seamless connection all software tools, and implementation of proprietary validation process.

HYBRID CLOUD INFRASTRUCTURE — Strategy, design architecture and hybrid cloud solutions to quickly scale ADAS infrastructure.
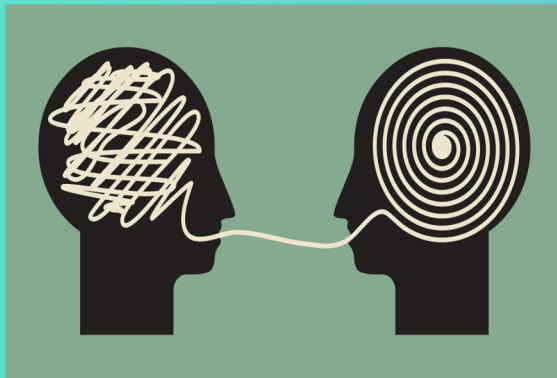
Challenges
- Must validate systems over a significant amount of uncommon situations
- Requires extensive testing of systems, which will take many years
- To prove better than human performance would require exposing vehicles to billions of driving miles
- Input simulations required

Three Requirements to Perfect Self-Driving Cars
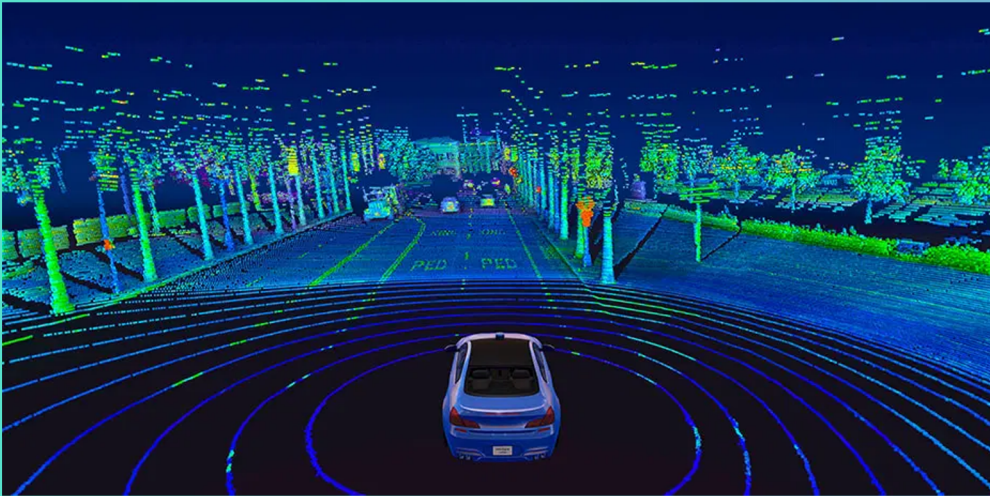
Perception

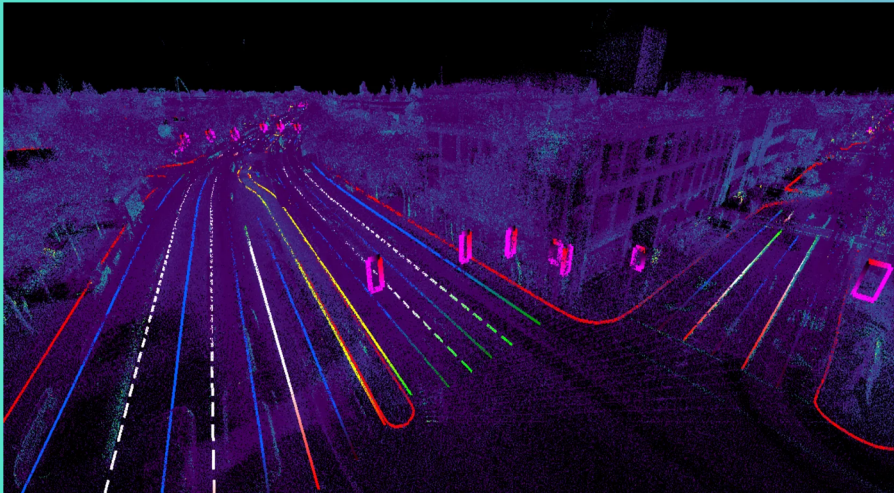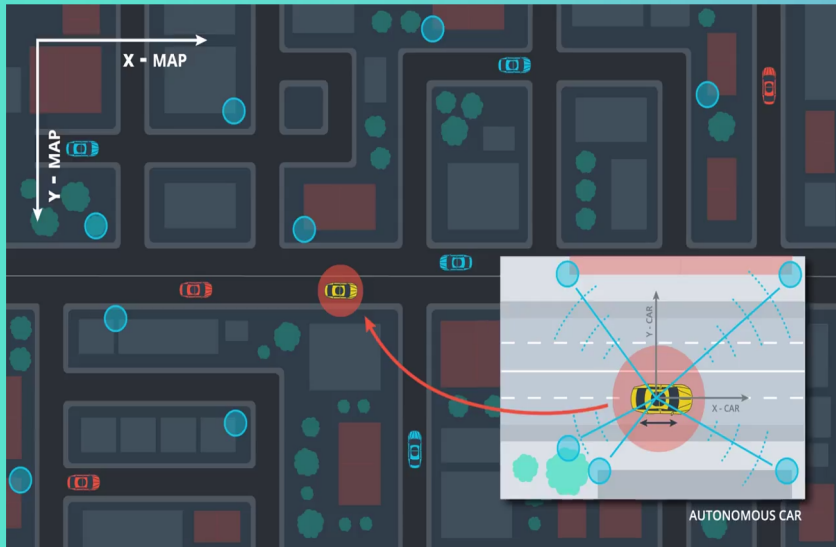## Mapping

Localization

Perception

- Reliable levels of perception with low number of test miles
- Two main approaches...
  - Radar, sonar, and cameras
  - Lidar augmentation

Mapping

- Granular, HD maps
  - Use vehicles equipped with lidar and cameras that travel among roads and create 3D, full 360 maps
- Feature mapping - only maps certain road features that enable navigation

Localization

- Identify a vehicle's exact position in its environment
- HD mapping
  - Compare perceived environment with corresponding HD maps
- GPS localization
  - Primarily uses GPS for approximate localization in combination with onboard cameras

Speeding up the Process

- Sharing data with third parties such as insurance companies
- Insurers are experts at assessing risks
- Expert risk assessors being involved could help encourage lawmakers to allow more autonomous cars on the roads for testing
- "If insurers are willing to account for the uncertainties, then it may speed up testing" - Jack Stilgoe

Questions

How safe would you feel with having more self-driving cars on the road in the coming decade?

Given the complications of making sure an automated system is safe, do you think certain automation levels should be restricted?

References

https://www.mckinsey.com/features/mckinsey-center-for-future-mobility/overview/autonomous-driving