



# Human Factors in the Coming Age of Driverless Vehicle

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**WSU** VENTURES AVAILABLE TECHNOLOGIES



**PUTTING SAFETY FIRST**  
Everyday wearable application with smartphone integration monitors fatigue and increases driver safety.

**LEARN MORE**

1 2 3 4 5 6

CH 18:58 2014/9/11



# About Jibo He



2003

Psychology



2006

Human computer  
interaction



2007

Visual cognition, eye-tracking, driver  
distraction



2010

Eye-tracking,  
statistics



2011

Driver distraction, driver  
fatigue



now





**distraction**  
human  
cognition  
interaction  
driving  
usability  
factors  
wandering  
computer  
user  
eye  
tracking  
Visual  
mind  
simulator  
experience  
cognitive  
HClgy  
driver  
Engineering  
programming



# About Human Automation Interaction Lab

- Eye-trackers
  - Tobii, SMI eye-tracker, and SR Research Eyelink-eye tracker
- Advanced driving simulator
- Advanced flight simulator
- Microsoft HoloLens
- Smartphones & smartwatches
- Google Glass
- NeuroSky EEG sensors





# Advanced Driving Simulator Upgrade Project

- Jibo He
- [Jibo.he@Wichita.edu](mailto:Jibo.he@Wichita.edu)





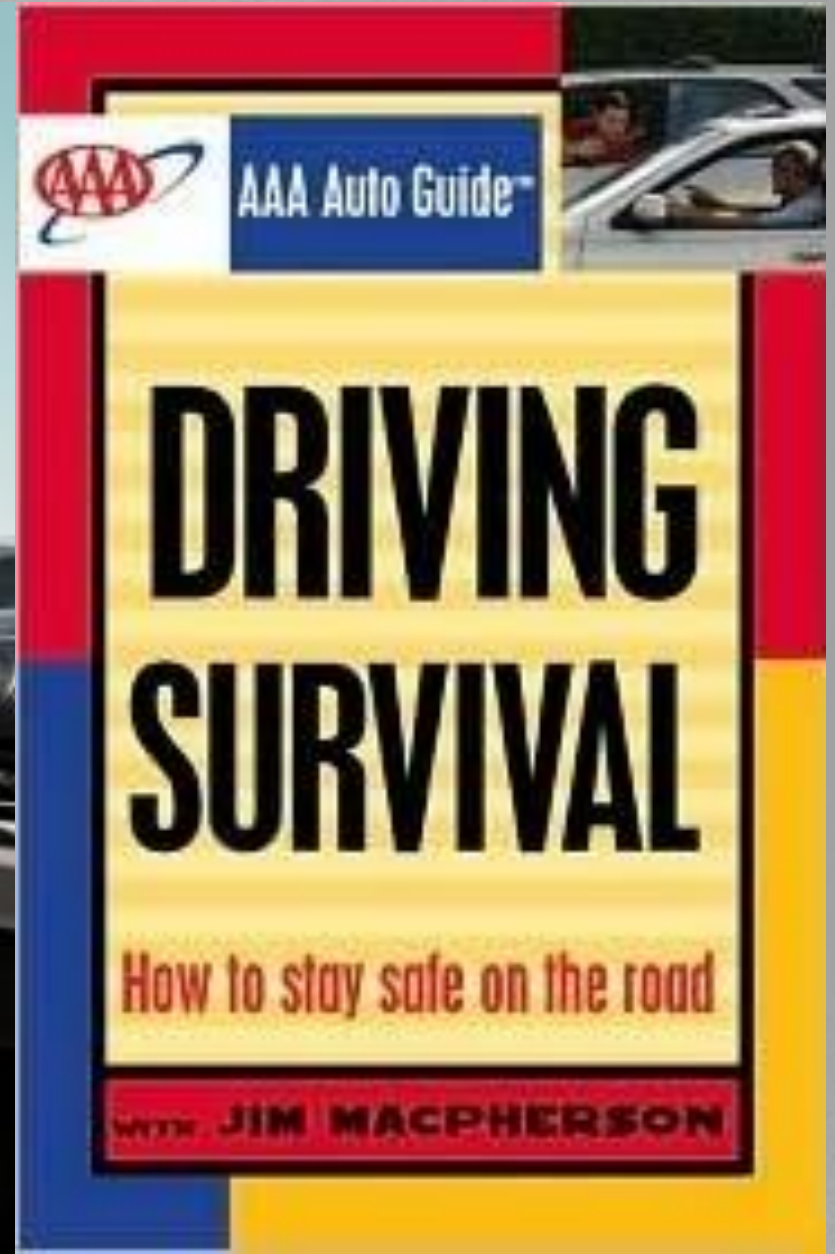


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# Driving Pleasure and Survival Needs



Sheer  
Driving Pleasure







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# Driving Pains





# Driving Difficulty



**Drunk Driving**



**Distracted Driving**



**Drowsy Driving**



**Telescopes Low Vision Driving**





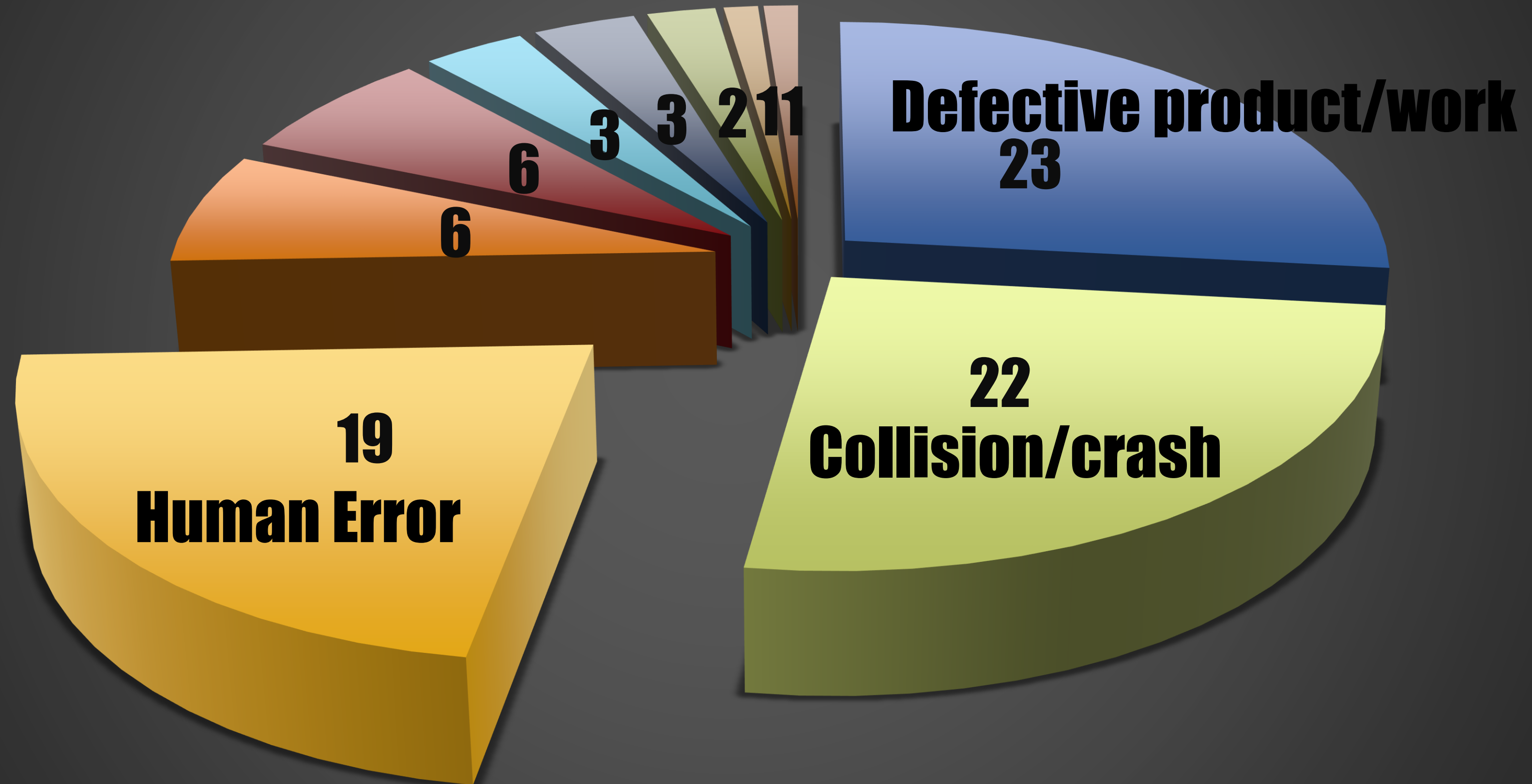
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***“to err is human”***



# Driving Casualty

**Top 10 global causes of liability loss by total value of claims  
(2011-2016)**







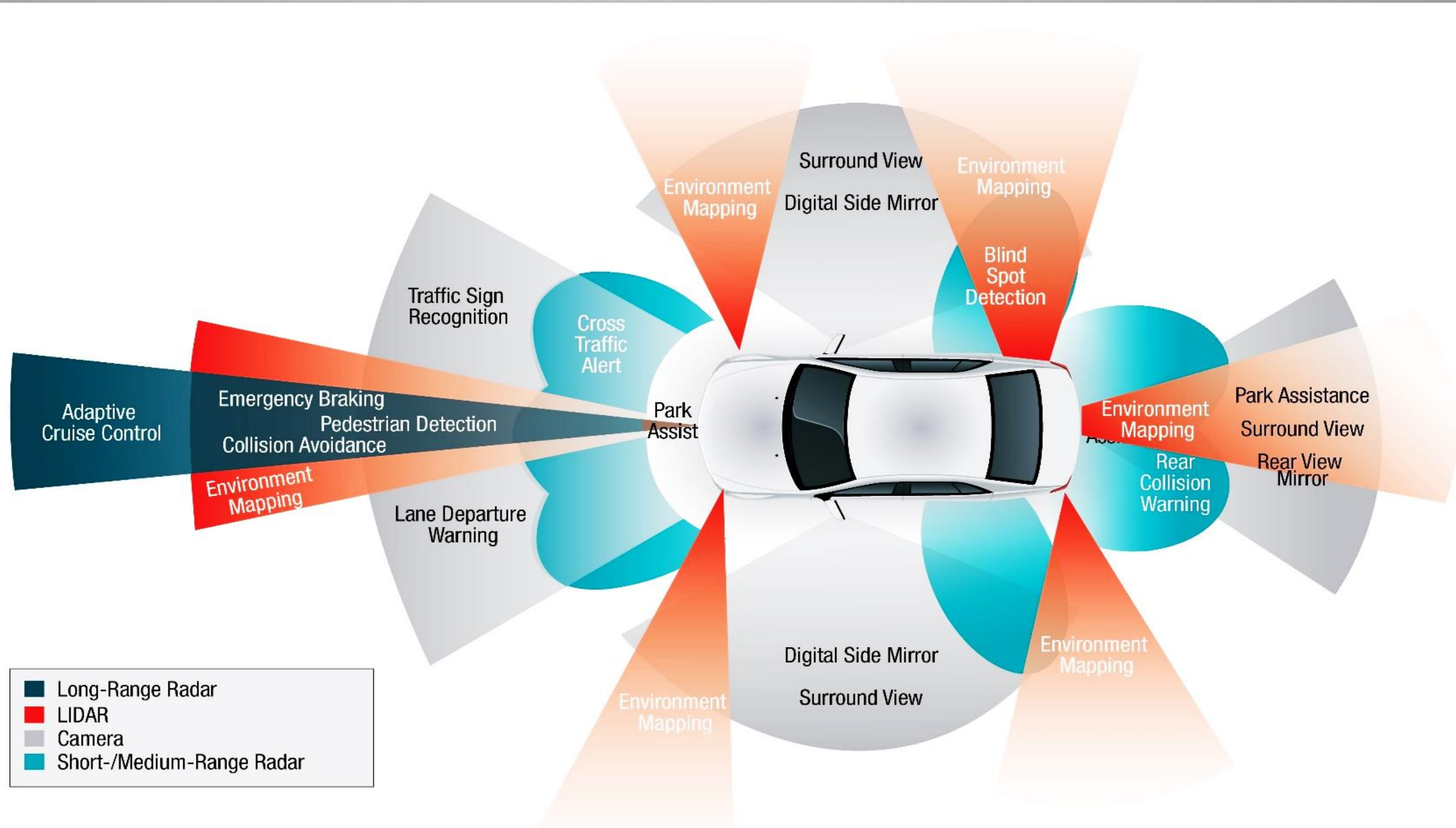
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# Driverless Vehicle

“ A robotic vehicle that is designed to travel between destinations without a human operator ”



# Sensors in Driverless Vehicle

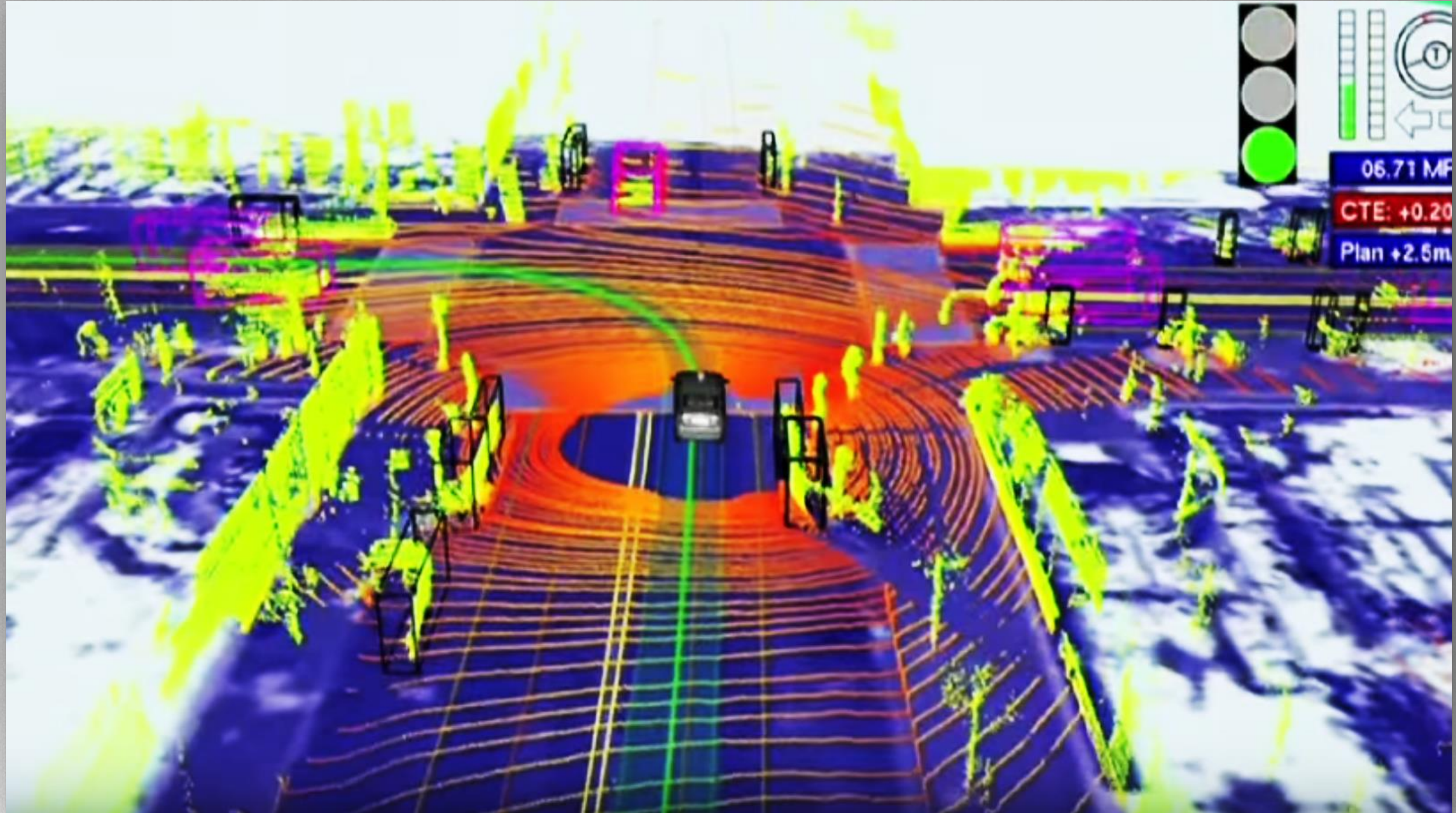






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# Sensors in Driverless Vehicle





# Brands of driverless vehicle



- ❖ **General Motors**
- ❖ **Ford**
- ❖ **Mercedes Benz**
- ❖ **Volkswagen**

- ❖ **Chang An**
- ❖ **Tesla**
- ❖ **Baidu**
- ❖ **Google**

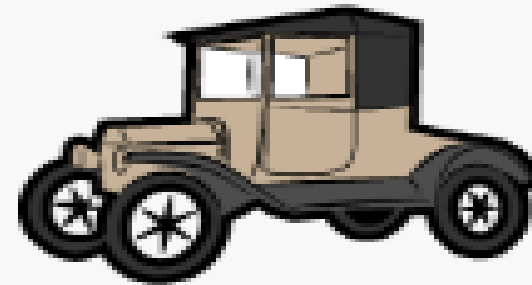
- ❖ **Audi**
- ❖ **Nissan**
- ❖ **BMW**
- ❖ **Volvo**

- ❖ **Didi**
- ❖ **Uber**
- ❖ **Toyota**



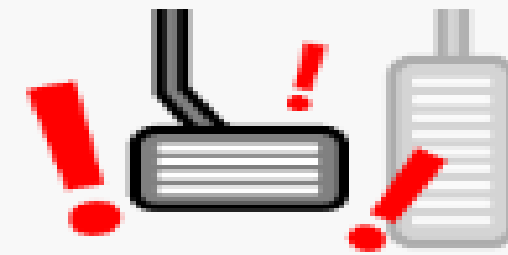
# Automation levels of driverless vehicles

## LEVEL 0



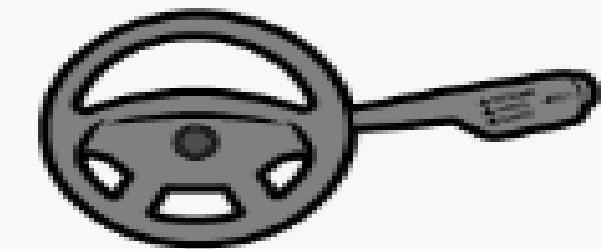
There are no autonomous features.

## LEVEL 1



These cars can handle one task at a time, like automatic braking.

## LEVEL 2



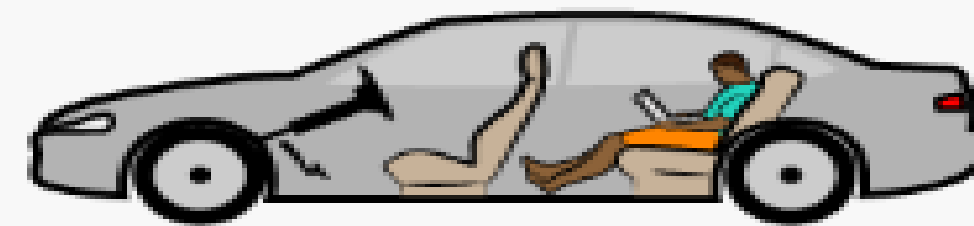
These cars would have at least two automated functions.

## LEVEL 3



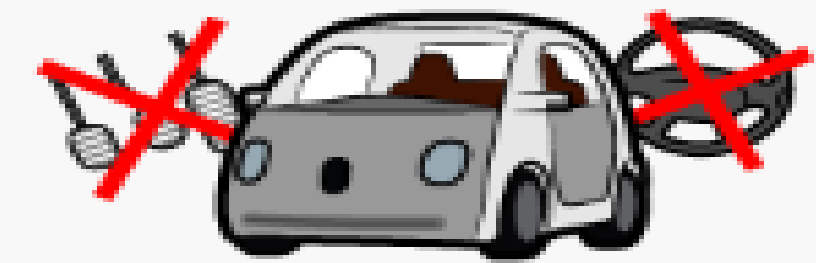
These cars handle "dynamic driving tasks" but might still need intervention.

## LEVEL 4



These cars are officially driverless in certain environments.

## LEVEL 5



These cars can operate entirely on their own without any driver presence.





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Your PC ran into a problem and needs to restart. We're just collecting some error info, and then we'll restart for you. (45% complete)

If you'd like to know more, you can search online later for this error: DRIVER\_IRQL\_NOT\_LESS\_OR\_EQUAL

**“to err is machine”**



# To err is machine, e.g. driverless vehicle

## *Tesla driver killed in first fatal crash using Autopilot*



**“ Tesla explained that the vehicle's sensors, which help to steer the car by identifying obstructions, had failed to recognize the white side of the tractor trailer against a brightly lit sky.”**



# To err is machine, e.g. driverless vehicle

## *Google's Self-Driving Car Caused Its First Crash*





# Human Factors Issues for Driverless Vehicles

## ***Situational Awareness***

- **Computer Vision Algorithms lack Situational Awareness (Level 3): project the future actions of the elements in the environment**





# Human Factors Issues for Driverless Vehicles

## Trust & Complacency







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# Human Factors Issues for Driverless Vehicles

## *Insurance and Legal Issues*

- **Federal Automated Vehicles Policy**
  - ❖ **Who must carry motor vehicle insurance ?**
  - ❖ **How to allocate liability when a crash occurs ?**
  
- **Insurance Information Institute**
  - ❖ **Liability laws might evolve to ensure autonomous vehicle technology advances are not brought to a halt.**





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# Human Factors Issues for Driverless Vehicles

## *Customers Acceptance*

- **An Insurance Information Institute Pulse survey (2016)**
  - ❖ **55 percent of consumers: “would not ride in an autonomous vehicle.”**
  - ❖ **50 percent: “manufacturer should bear responsibility for an accident”**
  - ❖ **Only 25 percent : “willing to pay more for a driverless car to cover the manufacturer’s liability in case of an accident.”**

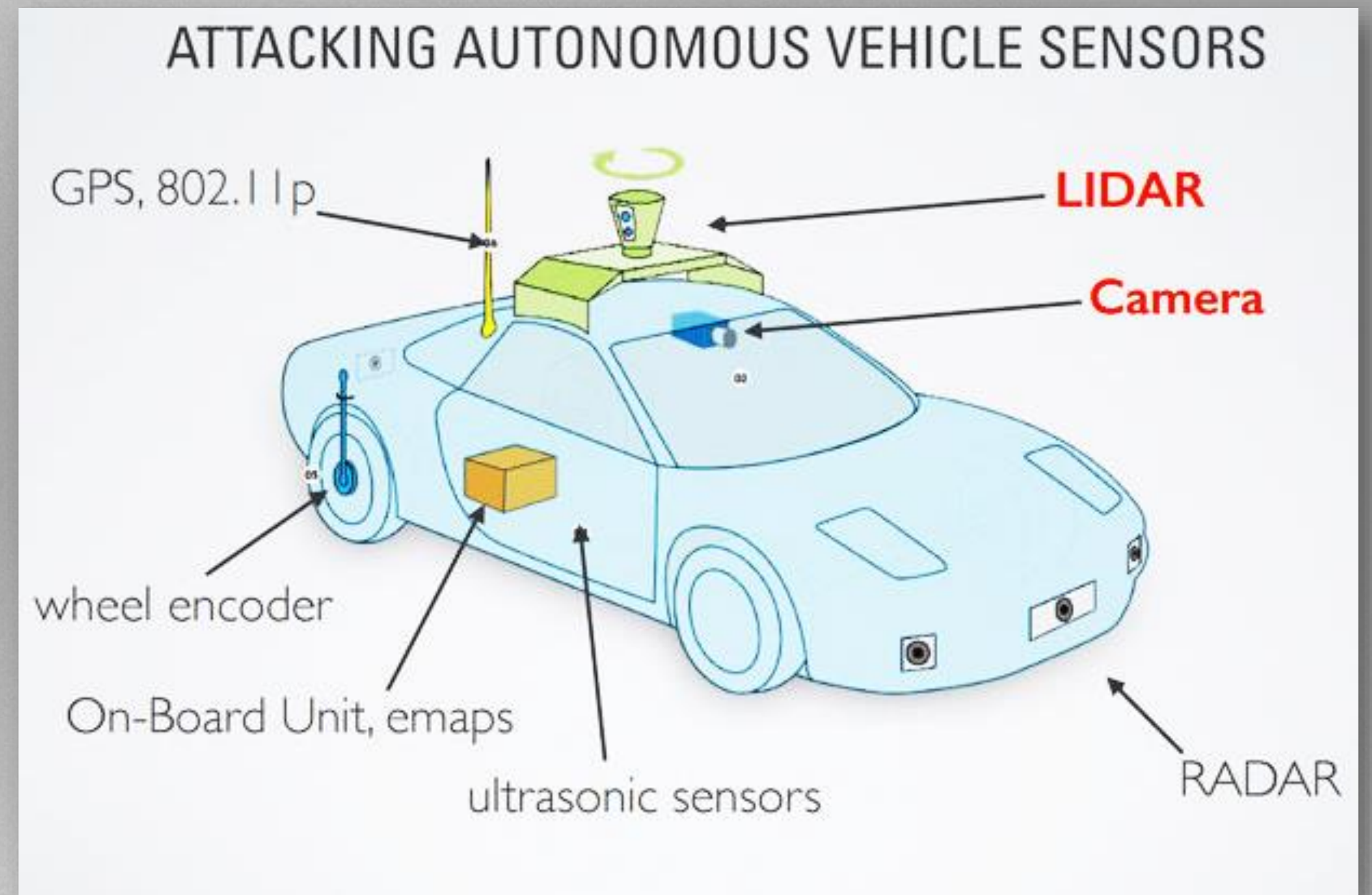


# Human Factors Issues for Driverless Vehicles

## Security and Privacy

**“The hackers can take control of the brakes, engine or other components of a person's car remotely.”**

**The Guardian (2016)**





# Human Factors Issues for Driverless Vehicles

## Control Take-Over





# Human Sensing Technologies

## Fatigue Detection



a



b



c



d





# Human Sensing Technologies

## *Nvidia's AI Co-Pilot at CES'2017*

- ✓ **Face recognition**
- ✓ **Head tracking**



- ✓ **Gaze tracking**
- ✓ **Lip reading**





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# Take-Home Message: Driverless Vehicle

**“ A robotic vehicle that is designed to travel between destinations by integrating human factors & technology ”**



# References

- He, J., Choi, W., Yang, Y., Lu, J., Wu, X., & Peng, K. (2017). Detection of driver drowsiness using wearable devices: A feasibility study of the proximity sensor. *Applied Ergonomics*.
- He, J., Roberson, S., Fields, B., Peng, J., Cielocha, S., & Coltea, J. (2013). Fatigue detection using smartphones. *Journal of Ergonomics*, 3(03), 1-7.
- Ren, Z., Wang, C., & He, J. (2013, June). Vehicle detection using Android smartphones. In *Proceedings of the Seventh International Driving Symposium on Human Factors in Driver Assessment, Training, and Vehicle Design, Bolton Landing New York*
- Fields, B. M., He, J., Nepomuceno, J. A., Roberson, S., Plummer, B. A., Houdek, K. C., & Jain, N. (2014). *U.S. Patent No. 8,876,535*. Washington, DC: U.S. Patent and Trademark Office.
- Seppelt, B. D., & Lee, J. D. (2007). Making adaptive cruise control (ACC) limits visible. *International journal of human-computer studies*, 65(3), 192-205.