Artificial Intelligence in Solar Cars

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Who am I?

- Senior at Okemos High School in Okemos, Michigan
- Starting Software Engineering at the University of Michigan this fall
- Captain of the Okemos Solar Racing Club
- Winner of the 2019 Governor's High School Cyber Challenge
- Winner of half a dozen hackathons

What is Artificial Intelligence?

- Teaching a computer to do things hard to algorithmically define
- Computer vision, while technically not AI, is what we will be focusing primarily on and is commonly what people associate with AI when they see a self driving Tesla

How does this apply to Solar Cars?

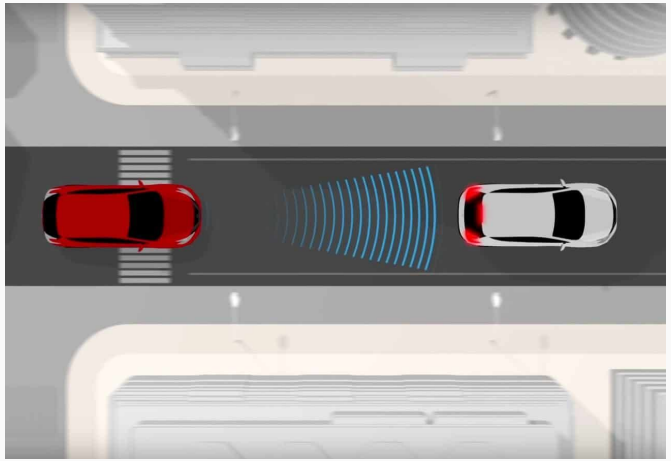
SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) AUTOMATION LEVELS

Full Automation

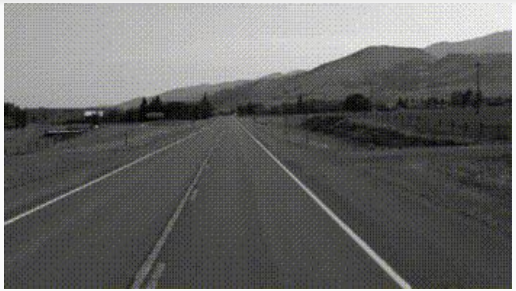
0	1	2	3	4	5
No Automation	**Driver Assistance**	**Partial Automation**	**Conditional Automation**	**High Automation**	**Full Automation**
Zero autonomy; the driver performs all driving tasks.	Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.	Vehicle has combined automated functions, like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times.	Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice.	The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle.	The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle.
Current Solar Cars	Many Current Cars	Current Stage of Tesla Autopilot	Traffic Jam Chauffeur	Mcity Car →	

Why would this be beneficial?

- Increase efficiency
  - Automated cruise control and precision steering
  - Lighter vehicle without need for a driver
  - Lower energy consumption (fewer watt hours per mile)
- Improve safety and reduce risk
  - No driver = no driver to be in danger
  - With human assistance, it's like 2 sets of eyes on the road, both monitoring with very different methods
  - With a computer integrated heavily in the car, it is much more in touch with system data and can sooner identify possible areas of concern



AI Application Part 1 - Lane Detection

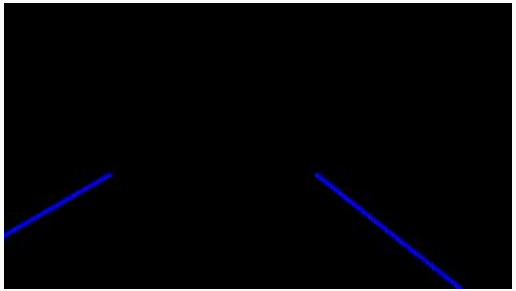
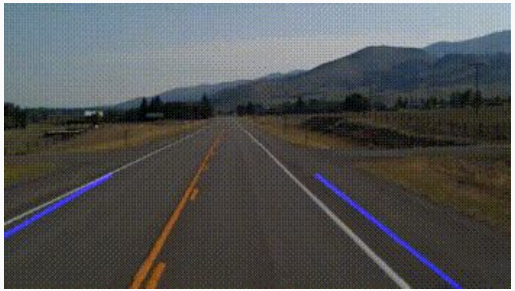
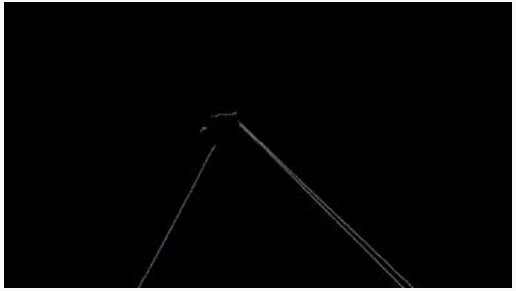
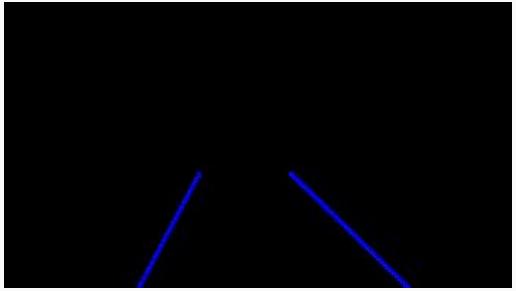
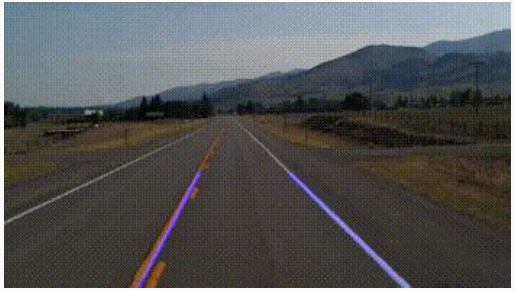




1st Row: Original, Blurred Grayscale, Edges

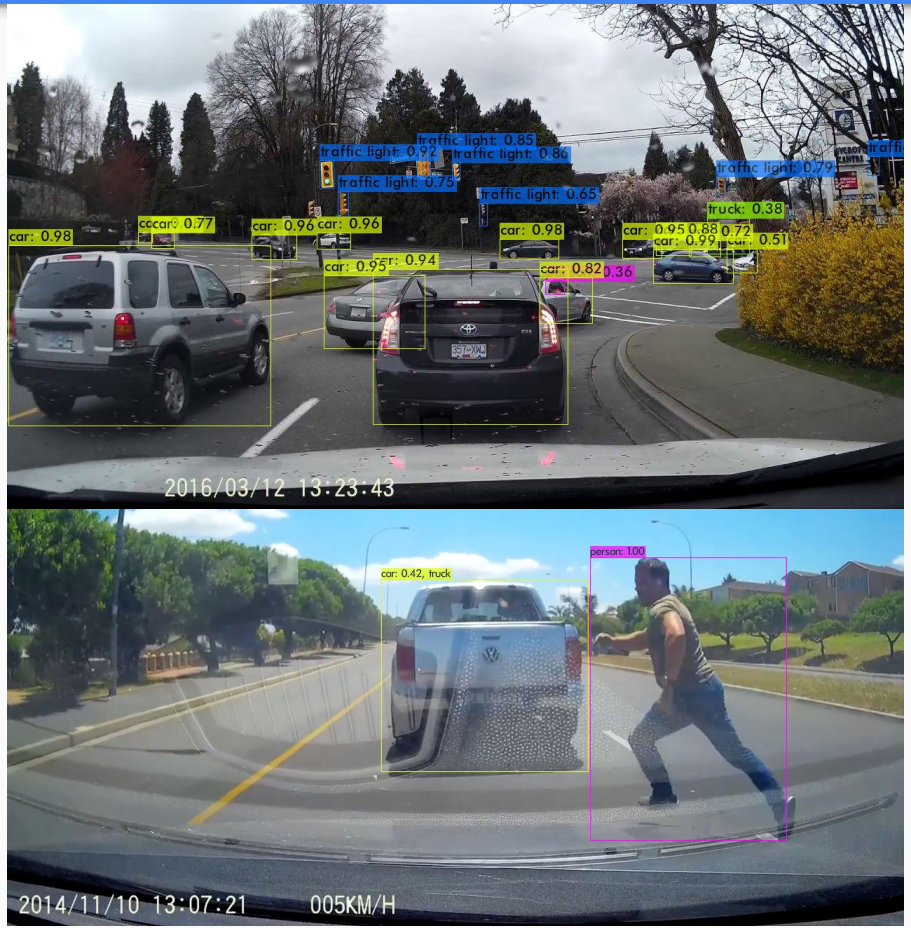
- The first row is used in both test cases
- The next two rows do the same thing

2nd Row: Line Mask, Overlay on Original

3rd Row: Crop, Line Mask, Overlay on Original

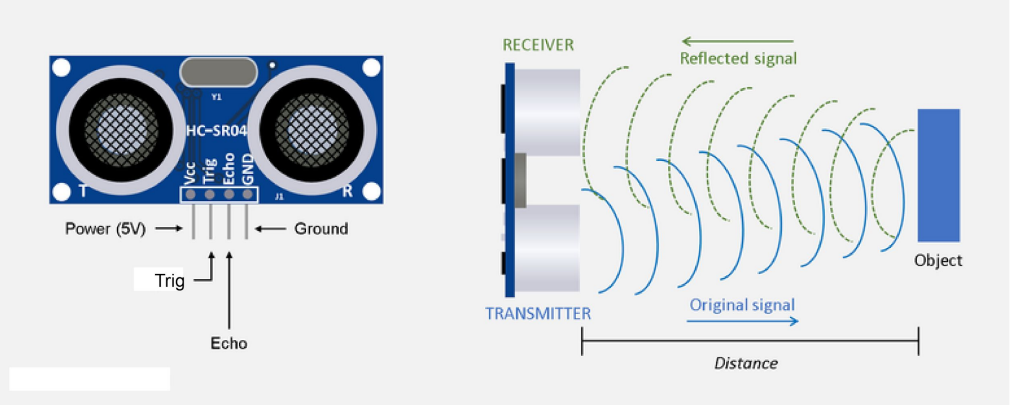






AI Application Part 2 - Safety



How does Tesla do it?

- A Raspberry Pi Model 4B has 13.5 GFLOPS
- The newest Tesla HW3 has roughly 10 TFLOPS (just shy of 1000x the Raspberry Pi's AI Power)
- Ultrasonic sensors can be used as an alternative for weaker systems like the Pi



Questions

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Additional Readings:

- YOLO Darknet Model Github
- Lane Detection with a ML Approach
- Tesla Model S Computer Performance
- Common Consumer Machines GFLOPS Chart