THE GEORGE WASHINGTON UNIVERSITY
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IoT Gateway for the Roadway

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Objective

To create secure infrastructure for an autonomous car roadway.

- Provides security
  - Integrating intelligent isolation
  - Monitoring IoT data
  - Enabling Proprietary applications
- Securely manages IoT
  - Device communication
  - Device infrastructure
  - Data aggregation

*IoT: Internet of Things

Setup

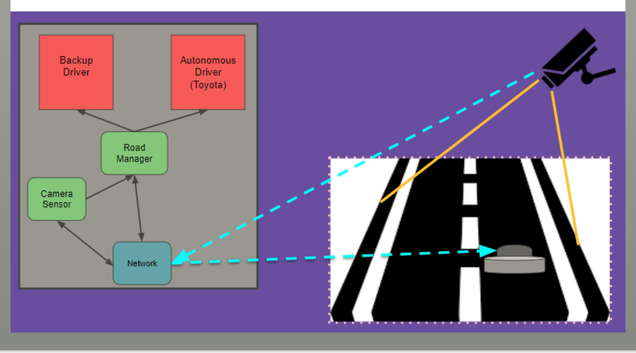
Physical:

- iCreate Robot as autonomous vehicle
- MediaTek LinkIt One
- Wireless Internet Protocol (IP) camera

System:

Components of Composite OS:

- Autonomous Driver
- Autonomous Driver Backup Driver
- Road Manager
- Camera component



Background

The roadway is an incredibly dangerous and chaotic place, causing < 103 deaths/day.

Tesla

Tesla driver dies in first fatal crash while using autopilot mode

The autopilot sensors on the Model S failed to distinguish a white tractor-trailer crossing the highway against a bright sky

Danny Yadron *and* Dan Tynan *in San Francisco*

Thu 30 Jun 2016 19.14 EDT

Jeep hackers at it again, this time taking control of steering and braking systems

THE VERGE

Car hacking is the future – and sooner or later you'll be hit

The Guardian

Alex Hern

Uber

Uber crash shows 'catastrophic failure' of self-driving technology, experts say

Concerns raised about future testing as footage suggests fatal collision in Arizona was failing of system's most basic functions

Sam Levin *in San Francisco*

@SamTLevin Email

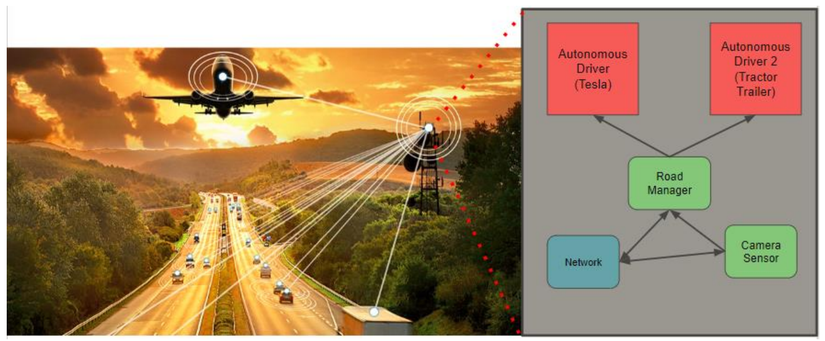
Thu 22 Mar 2018 15.32 EDT

How It Works

- Devices: Autonomous Cars and Cameras (sensors)
- Gateway: Acts as the central aggregator for the data from each IoT device

Why introduce a camera overlooking the road?

- 3rd party applications control each autonomous vehicle
- Apps reside on the Gateway as isolated components
- Aggregate sensor data so autonomous car can make better driving decisions
- Allow different companies to put autonomous car apps on the same gateway
- Collaborative use of redundancy from available sensors



Technical Features

Multi-Sensor Aggregation

- Increase Confidence
- Redundant Sensing Data
- Integrate a variety of sensors to enable a true picture of the road
- Create a central source of non-conflicting driving decisions

3rd Party Applications

- Edge Computing
- Isolation allows for secure peace of mind
- Different proprietary applications execute in parallel
- Allow backup drivers in case one fails

System Security

- Microkernel design
- Process level isolation
- Only authorized apps or entities can access or modify certain data
- Detect and shut down compromised component

Security

- Technical features enable security for the gateway, cars, and applications

Capabilities using Camera data

- Corroborate car location
- Detect and react to obstacles unseen by on-car sensors
- Detect and react if car is hijacked and driven off-route

Capabilities of System Properties

- If car application is buggy or compromised:
  - Prevent effects from spreading
  - Detect and shut down app
  - Defer to backup driver
  - Direct car to stop at safe location

Conclusion

Provide secure infrastructure capable of scaling to:

- Any roadway
- Any number of autonomous cars
- Any number of car manufacturers

Finally, system properties ensure the safety and physical integrity of riders, pedestrian, and surrounding environment