Computer Vision Technologies for Driver Safety Applications

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Chief Executive Officer
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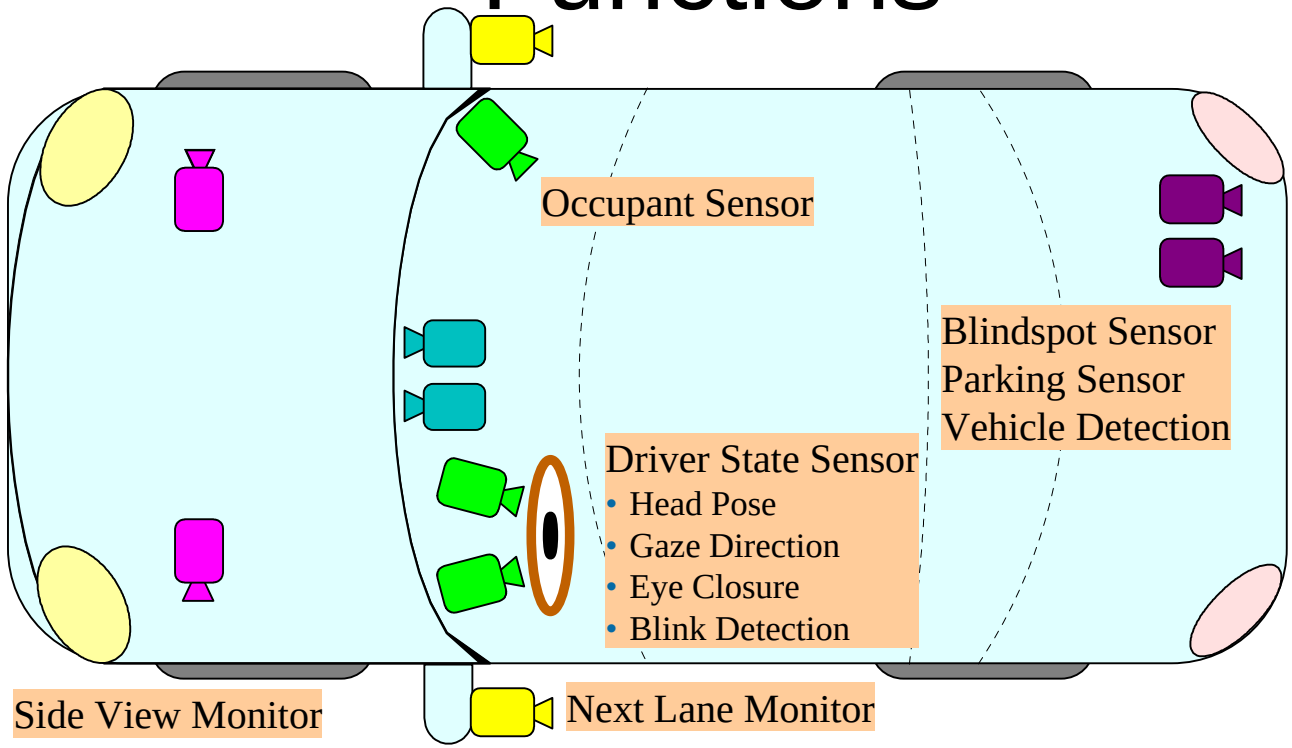
Smart Car Functions

Car Navigation
Traffic Information
Parking Information
Internet Brokering
Mobile Office
Entertainment

Lane Departure
Road Sign Recognition
Road Hazard Detection
Pedestrian Detection
Obstacle Detection
Vehicle Detection



Active Safety Systems

- Smart Airbags
- Collision Avoidance (Front, Side, Rear)
- Pedestrian Collision
- Lane Keeping
- Lane Changing
- Intelligent ACC

Advanced Driver Assistance Systems

- Night Vision HUD
- Distraction / Inattention Mitigation
- Fatigue Detection
- Workload Management
- Driver Identification
- Comfort
- Parking Assistance

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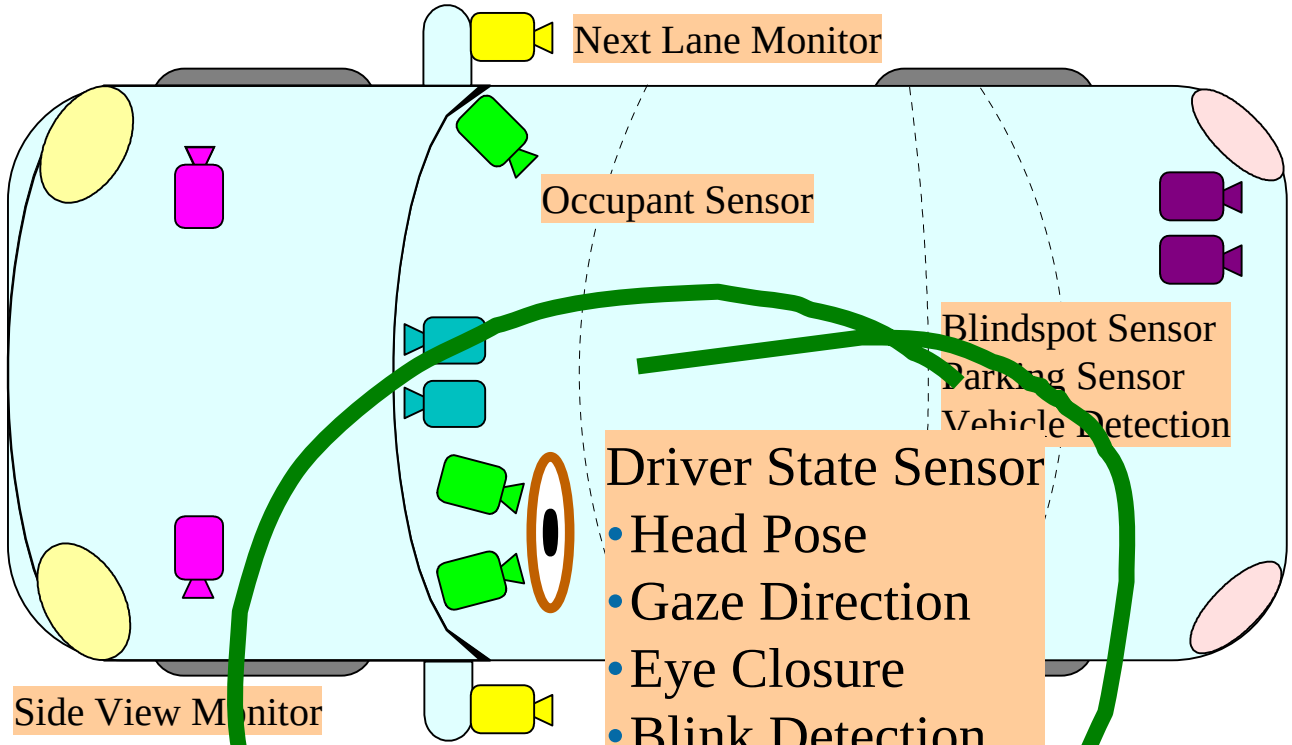
Our Niche…



Lane Departure
Road Sign Recognition
Road Hazard Detection
Pedestrian Detection
Obstacle Detection
Vehicle Detection

Driver State Sensor
- Head Pose
- Gaze Direction
- Eye Closure
- Blink Detection

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Demonstration

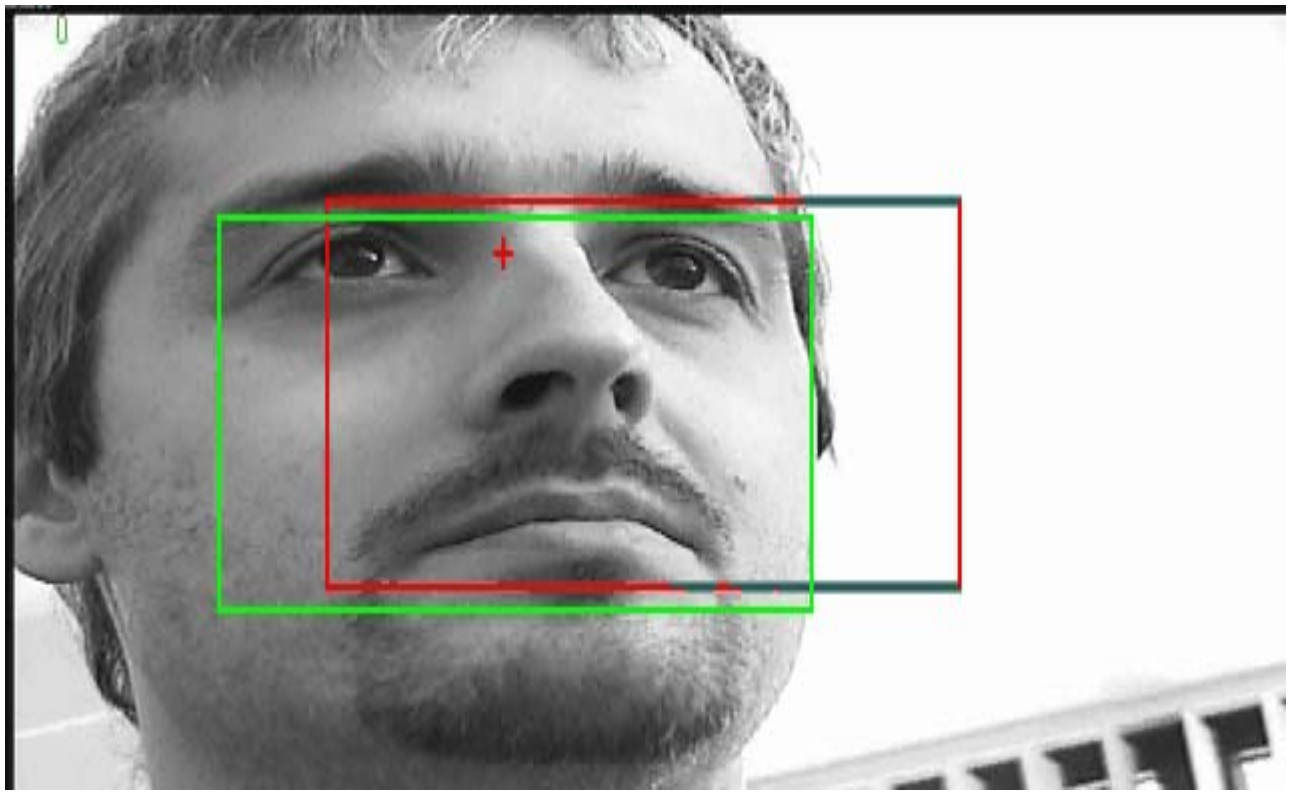
Product Requirements

User acceptance will require::

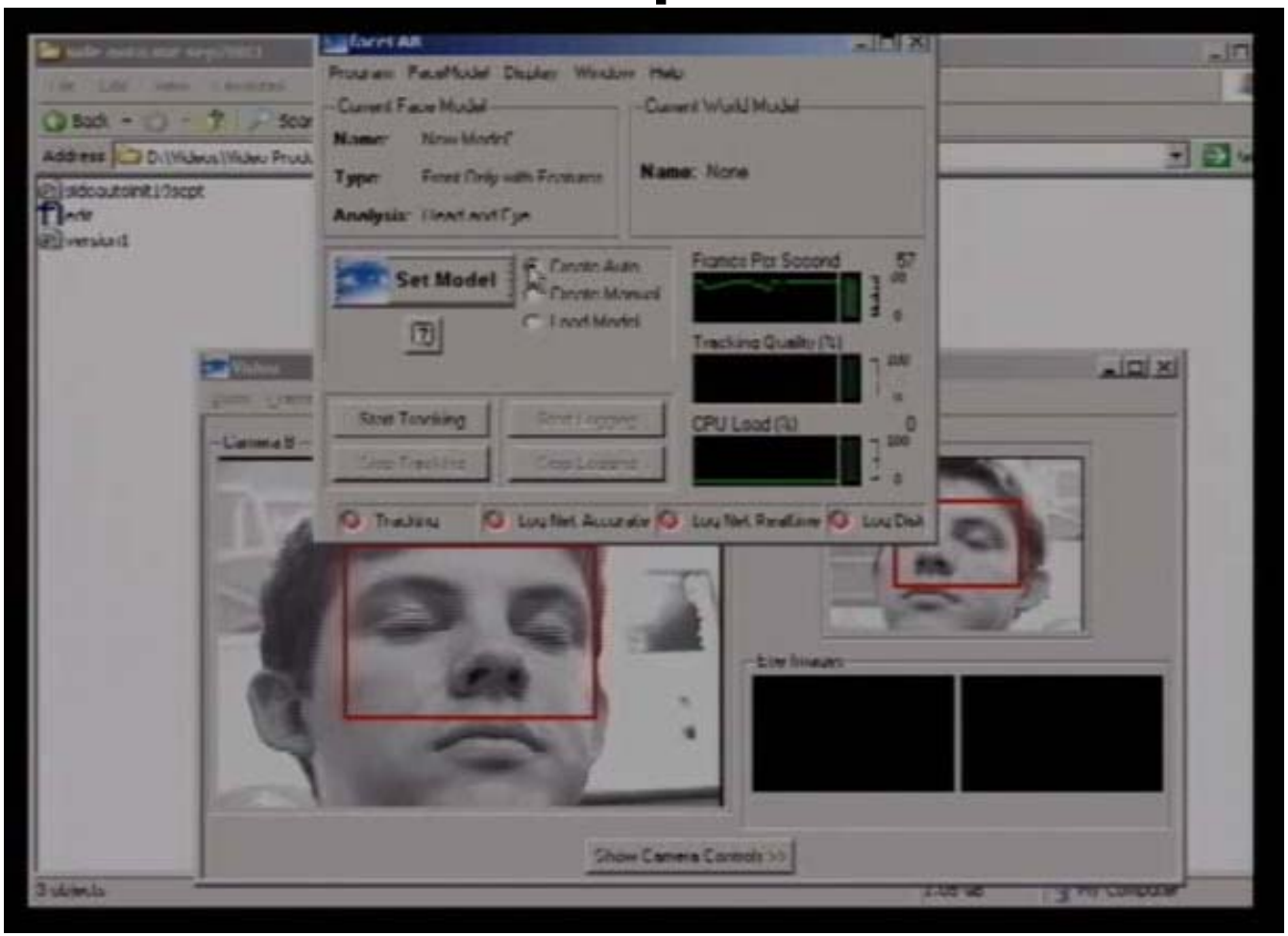
- Autonomous
  - Real time operations with no intervention or training
- User independent
  - Age, race, facial hair, eye & sun glasses (> 95%)
- Robust
  - Failure Detection + Automatic Recovery (> 95%)
  - Lighting insensitivity
  - Wide range of head movement. (+/- 90%)
  - *Sensor redundancy with scalability (2nd generation)*
- Functional
  - Eye Tracking (movement, blink, eye opening, *gaze*)

Automatic Initialisation

3D Tracking



Improved Operations



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Redundancy

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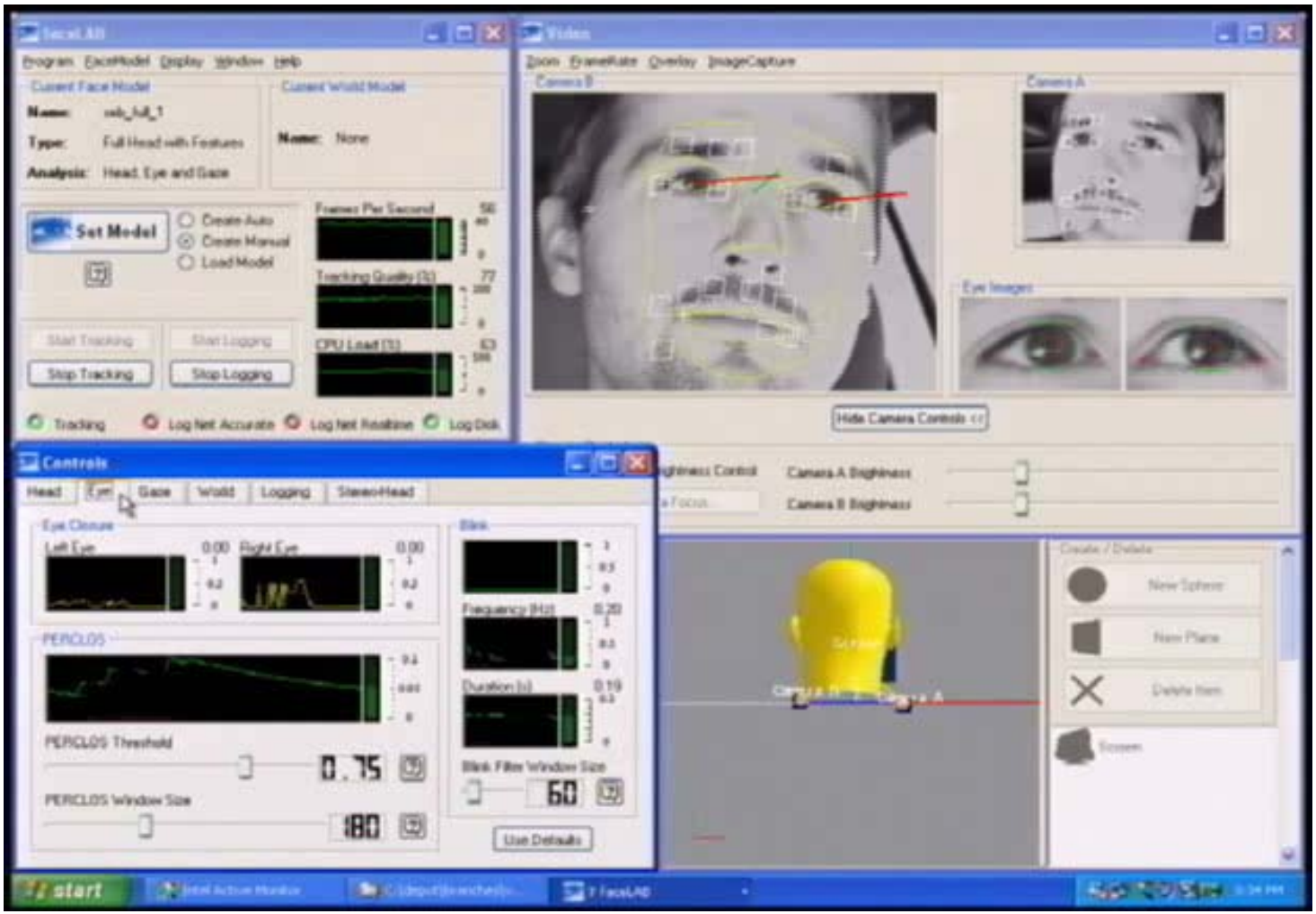
High Dynamic Range



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Eyes on Road

- Seeing Machines has developed an “Eyes on Road” demonstration for an OEM customer.
- Warnings provided through a HMI if the driver’s gaze is not directed on the road.
- The time allowed to look away from road is *adaptive*. The faster the car travels the less time to look away is permitted.
- The system works automatically for all drivers with no setup or manual intervention required.

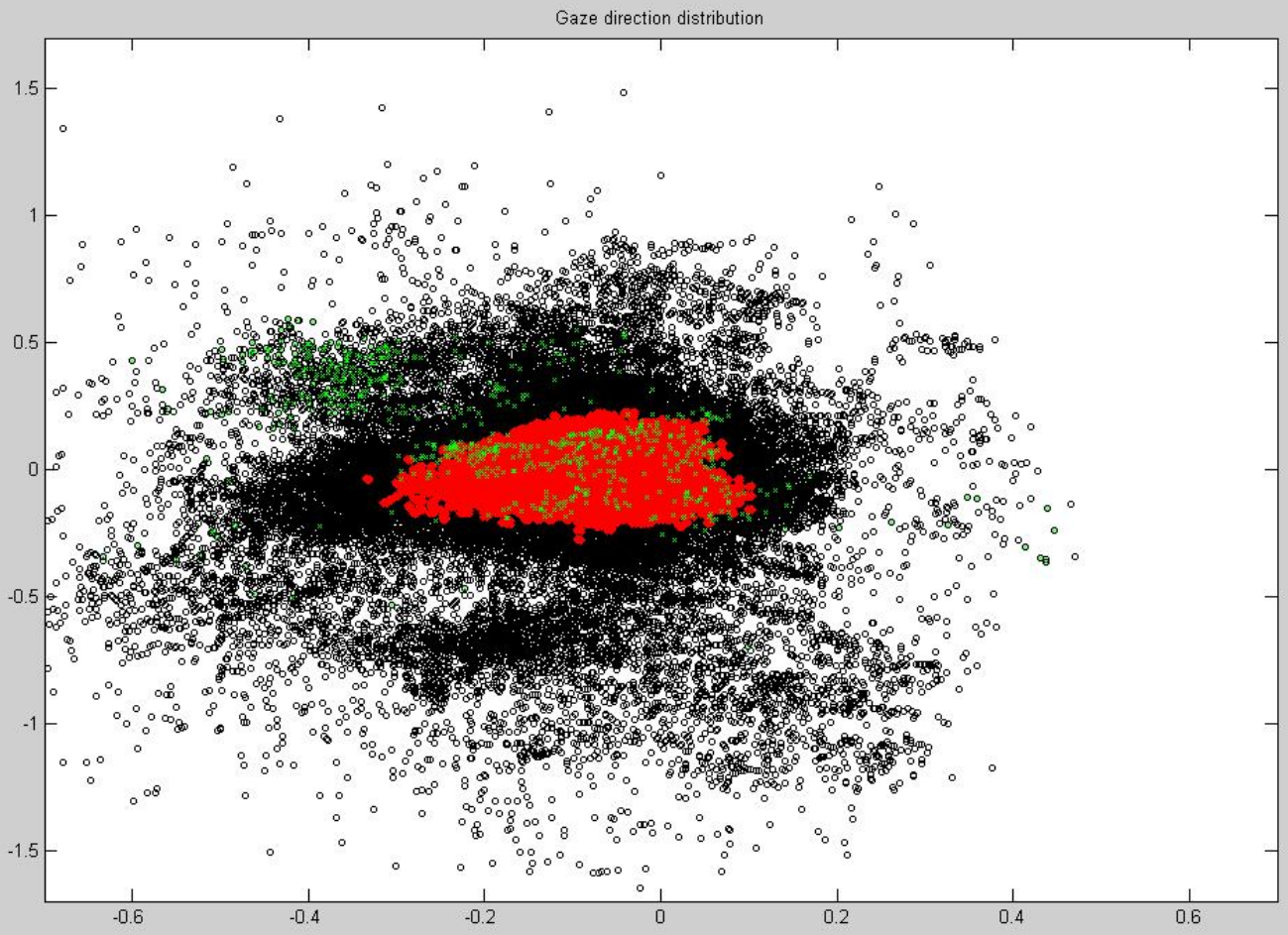
The Setup


Auxillary Battery
IBS Battery Monitor
IBS Solenoid
Inverter
GEL-TECH

Hidden Markov Model

- A Hidden Markov Model with two states “on road” and “off road” is employed to classify driver attention online. The “on road” attention cluster is modeled as a Gaussian centered on the road ahead.
- Parameters of on road cluster are derived from the observations in the initial training period (2.5 min) as well as the state transition matrix. Training begins once car is traveling > 50km/hr
- The Hidden Markov Model is continually retrained as new data is acquired to accommodate to shifts in driver behavior and drifts in measurements.

Head and Gaze Data



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Eyes on Road

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DSS Demonstration

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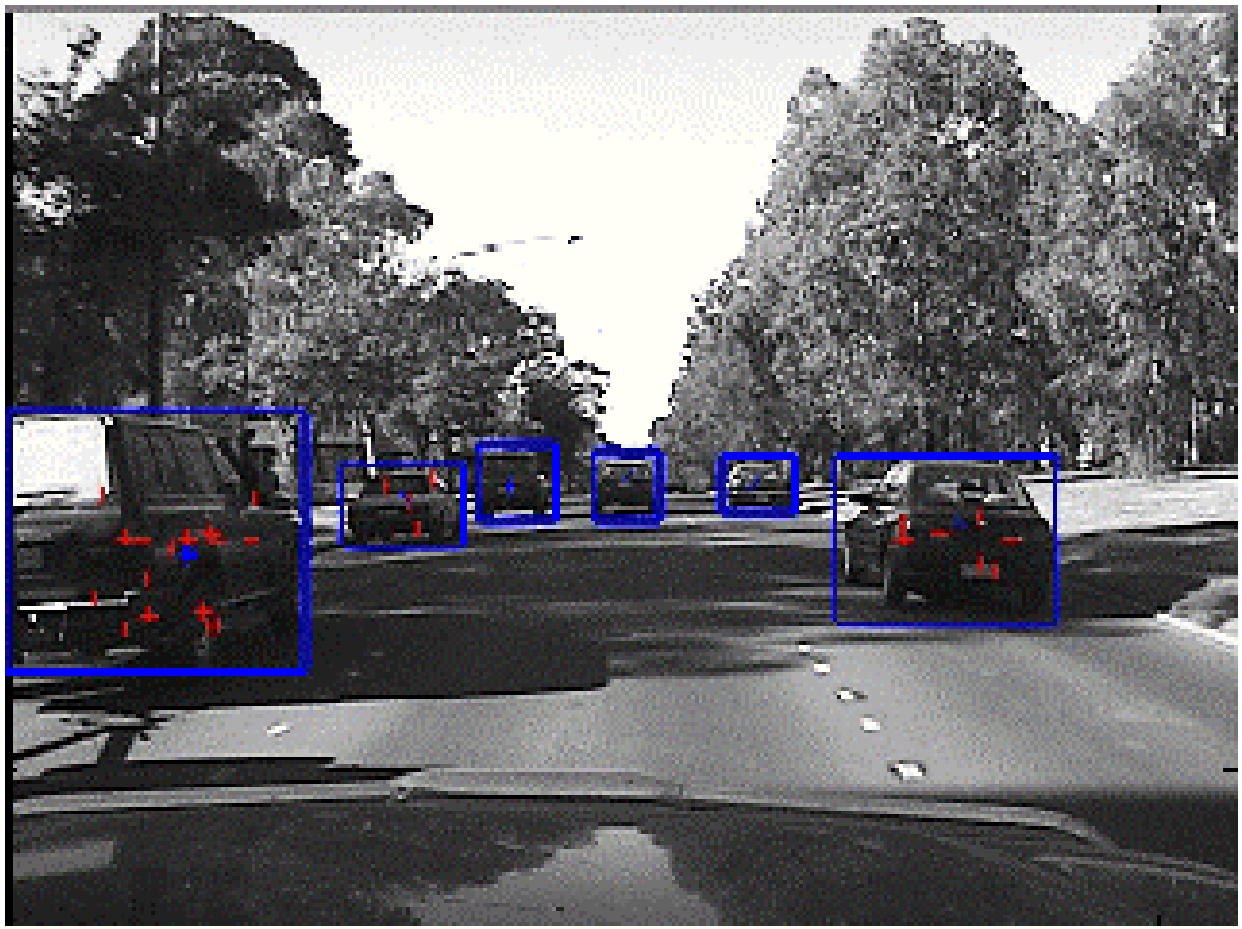
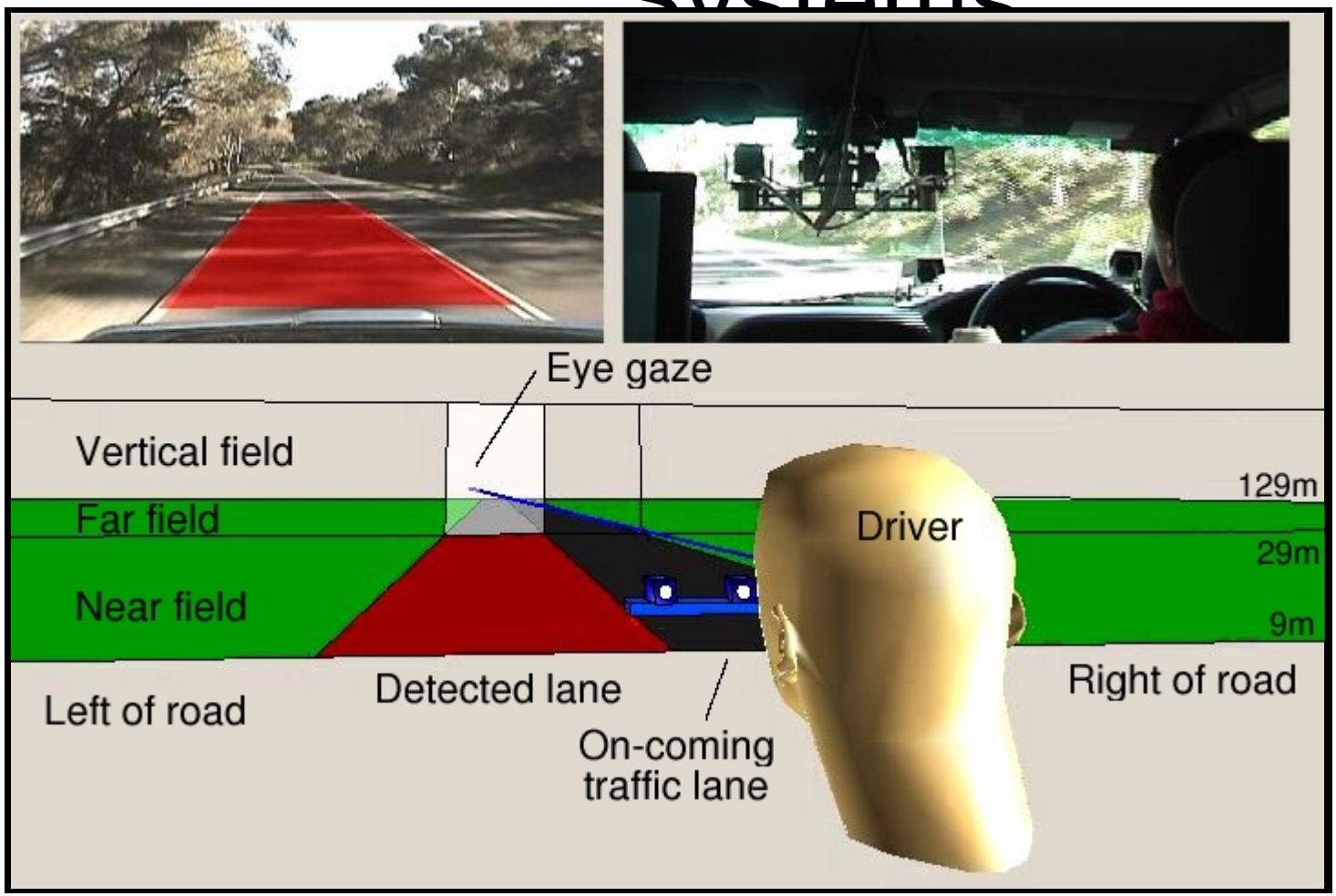
Lane Tracking

Multi Car Tracking



Integrated Systems



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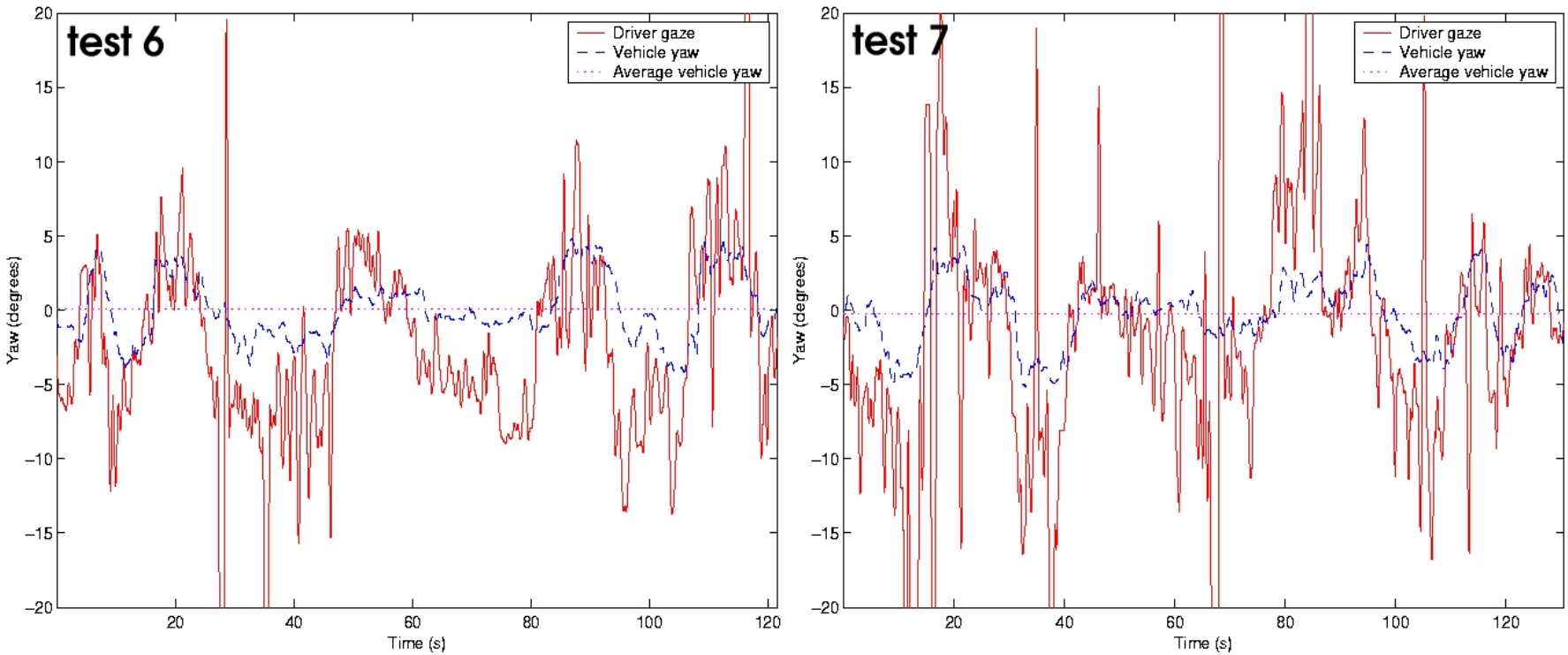
Driver Monitoring

Comparison between the driver's gaze and the yaw of the vehicle



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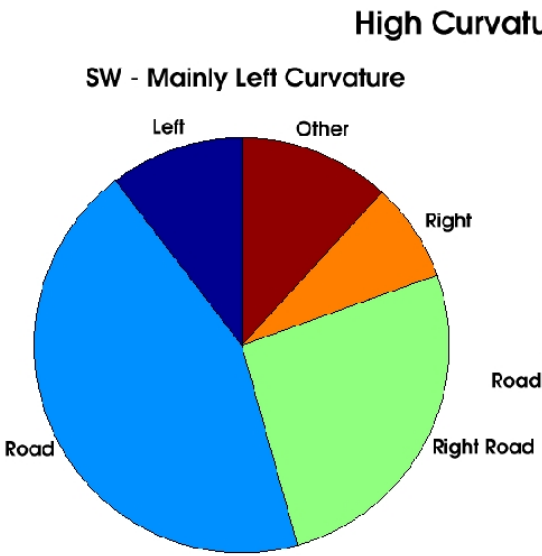
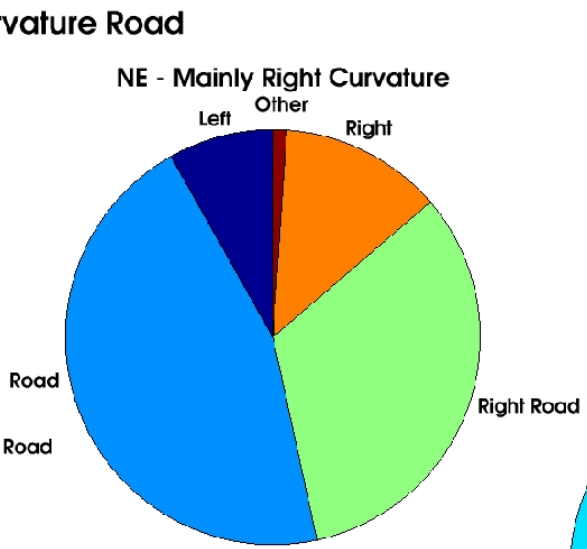
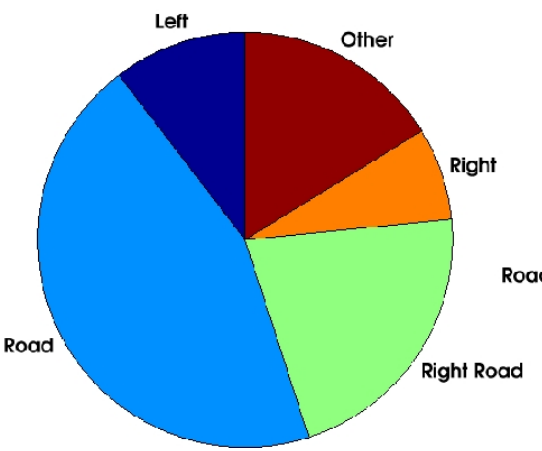
Driver Attention

Test 1

Test 2







Test 3

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Road Sign Reading

Summary

- Do not confuse research tools with auto products.
  - High fidelity and accurate human factors R &D tools
  - Once the problem is understood simplify into a product.
- Automotive manufacturers are cost driven.
  - Seeking low-cost and simple to use systems.
  - New technology is introduced progressively.
  - Later generation models become more sophisticated.
- Seeing Machines is aiming for a $250-$300 product, a limited number of simple functions

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