Synergy: Anytime Visual Scene Understanding for Heterogeneous and Distributed CPS

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Challenge

- CPS systems share limited information
- V2V limited to sharing speed/position
- V2I limited by region and re-routing

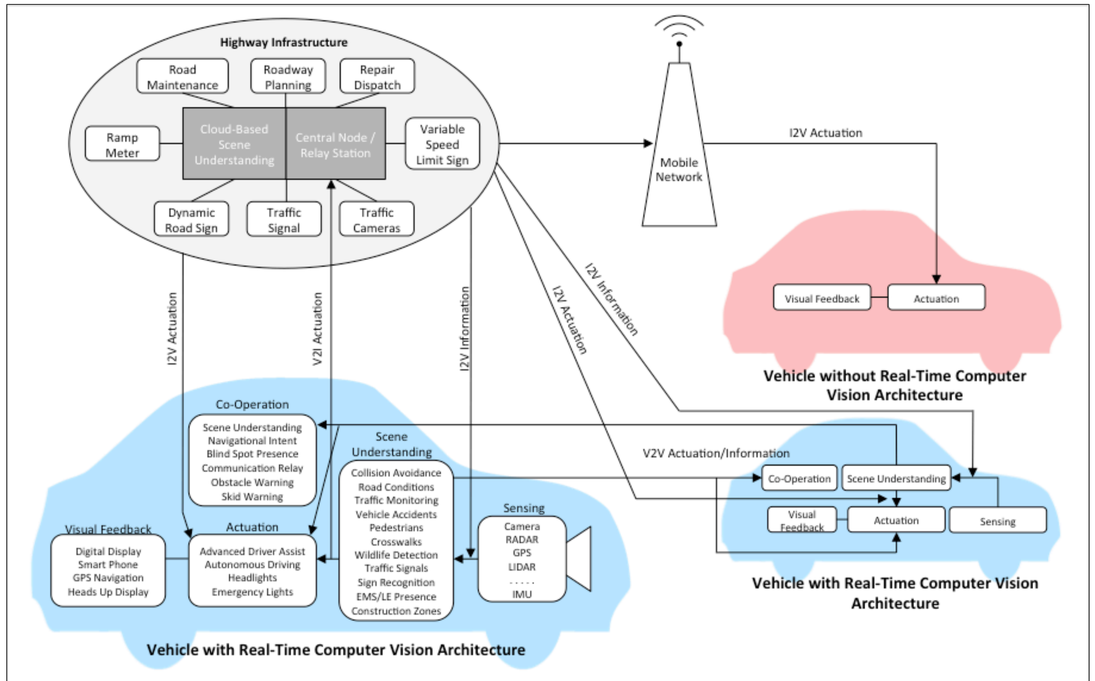
Solution and Scientific Impact

Vision-based architecture with:

- Integrated edge-cloud processing
- Hardware acceleration of anytime and coop. scene understanding methods
- Seamless communication of scene understanding data (V2V and V2I)
- Managing security and privacy without impacting QoS

Broader Impact

- Crash fatalities increasing annually
- Synergy between computer vision, machine learning and cyber-physical systems will lead to a safer, cheaper and smarter transportation sector
- Co-advised students, co-taught multi-disciplinary courses, co-organized workshops, deployment on the road



The roadway CPS consists of heterogeneous sub-systems, namely, a vehicle CPS (shown in blue), vehicle-to-vehicle CPS, and a vehicle-to-infrastructure CPS. The sub-systems are capable of sharing rich scene information with each other to ultimately provide useful forms of actuation.

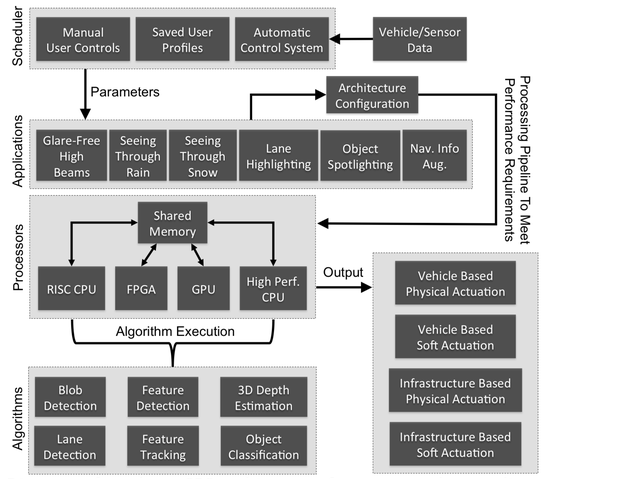
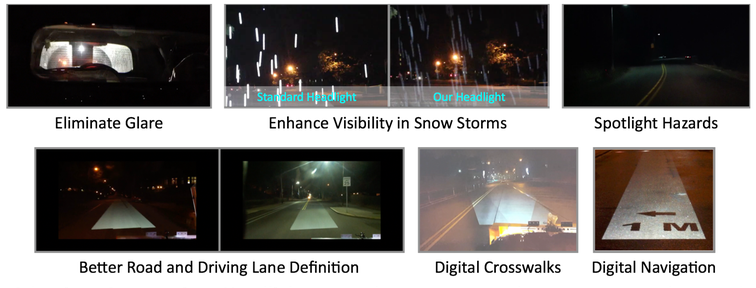


Diagram of roadway CPS architecture for scene understanding.

Cross-Modal Stereo Matching for the depth in the presence of challenging materials, e.g., glass, fabric, vegetation, lights, etc.



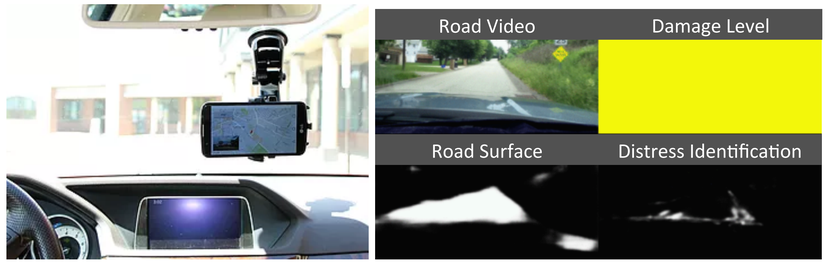
Eliminate Glare | Enhance Visibility in Snow Storms | Spotlight Hazards

Better Road and Driving Lane Definition | Digital Crosswalks | Digital Navigation

Adaptive Automotive Headlights can be programmed to react to the road environment in order to improve and enhance visibility for the driver. Awarded best research pitch at Three Rivers Venture Fair (2017).

3D Reconstruction of vehicles and their spatiotemporal motion from multiple, unsynchronized cameras from different view points.

Award #1446601, 09.09.2014



Automated Road Surface Condition Assessment from smartphone captured images and AI methods. Formed company RoadBotics to collect road data and perform analysis. Results provided to clients (e.g., all levels of government, planning organizations, and engineering/ construction firms) as easy-to-ready color-coded maps on a web-based platform.