Connected and Automated Vehicles - What’s new and Where are we going?

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Projects
Madison CV/AV Corridor – Connected Corridor

• Satisfies SPaT (Signal Phasing and Timing) Challenge
• Goal: 26 DSRC deployment
• TSP/MMITSS application
• Transit/VRU interaction apps
• Red light violation warning
• V2I general testing
• Simulation-to-design
• Preparation for 5G
Madison CV/AV Corridor – Connected Corridor
Reliability of Connected Vehicles Messages in DSRC Connected Environments

- Delivery range & quality of CV Messages
- N Park St & University Ave, Madison
- RSU transmitting SPaT and MAP messages
- Mobile OBU for measurements
- 40+ locations
- Range up to 284 meters, without obstructions
- Obstructions impact reception
Mobile AdHoc Networks for Vulnerable Road User Safety

- Infrastructure-free
- Smartphones in adhoc networks
- Broadcast presence messages
- Pedestrian crossing prediction
- Hierarchical mapping of conflicts
- Warning message to road users
Truck Platooning – Sign Occlusion

- Platooning beneficial
  - Fuel consumption
  - Emissions
  - Capacity
- Platoons occlude signs
- Simulation modeling of occlusion
- Over 400,000 scenarios modeled
- Significant sign occlusion (up to 80%)
HAVI – Human AV Interaction

• Full-scale driving simulation
• Partial automation research
• Driver reengagement
• Disengagement scenarios
• Driver attentiveness / distraction
• ADAS/CV driver notification strategies
• AV interaction with human drivers
• Vehicle assertiveness
Augmented Reality (AR) Traffic Signs

- AR signs
  - Reaction time (RT)
  - Distraction
  - Flashing rate
- Driving simulation scenarios
- AR signs direct attention to road
- Equivalent RT to post-mounted signs
- RT impacted by flashing rate
Communicating Non-CV Info to CV

- Evaluate RLR warning message
- Full-scale driving simulation
- Location of activation of warning system
Integrating AV into Transit Service

• Integrating AV with transit
  • Small urban areas great potential
• Online surveys
  • Travel habits, AV opinion/attitudes, transit usage
  • Eau Claire completed (217 responses)
  • Janesville and Wisconsin Rapids (just completed)
• Welcome automation and ADAS
• Fully automated transit vehicle
  • >75% concerned without operator
  • > 70% comfortable with an operator
REACT – Resident Engagement on Automated and Connected Technologies

- Rural engagement workshops
- Aging community outreach
- Low-income community outreach
- Users with disabilities
- Vulnerable industry sector research
- Public outreach and education events
- Multidisciplinary graduate degree development
Where are we going?
SC&C – Smart and Connected Communities

- Dynamic routing
- First-mile/last-mile connectivity
- Food and transit deserts
- Shared Madison data platform
- Smart parking algorithms
- IoT compatibility
- Urban analytics
Automated Shuttle Deployment

ROADWAY INTERACTIONS
- Other Vehicles
- Pedestrians
- Bicyclists
- Infrastructure

USER INTERACTIONS
- User Acceptance
- Passenger Comfort
- Usage Statistics
- Survey Responses

SYSTEM DATA
- Basic Vehicle Data
- Sensor Data
- Operating Data
- Vehicle Security

OPERATIONAL DATA
- Operating Limitations
- Obstacle Detection
- Winter Performance
- Changing Traffic Patterns

CONNECTED DATA
- Vehicle to Infrastructure
- Vehicle to Anything
- External Sensors
- Data Processing

Closed Course
On-Road Demonstrations
- College Campus
- First/Last Mile
- Tribal/Rural
Simulation Environment
Development Directions of CAVH

- Vehicle Based Approach
- IT & OEM Firms
- Infrastructure Based Approach
- Transportation Industry
- Connected Automated Vehicle
- Connected Automated Highway
- CAVH
System Based Approach: Simple Vehicle, Smart System (Simple Vehicle, Smart Road)

Technical Features:

- The majority of the sensor functions can be achieved using sensor systems on highway infrastructure or vehicle/highway system.
- The majority of the vehicle operation and control functions can be achieved via the cooperation of control systems on highway infrastructure and vehicle.
- Multiple redundant systems for sensor system, computing system, control system, communication system, information safety.