ITS Solutions for Pedestrian Safety in Detroit

Cal Poly, San Luis Obispo

San Luis Obispo, CA

Bernice Liu, Vanessa See, Curtis Yee, Kevin Yost
Existing Safety and Technology Problems

- The City of Detroit has the highest pedestrian fatality rate of any major city in the US
- The City lacks the capability of receiving real-time information on signal and intersection status over several important corridors
Project Location

Corridors
- Livernois Avenue
- Vernor Highway
- Michigan Avenue
- Jefferson Avenue

Characteristics
- No communication capabilities with TMC
- Generally growing population and relatively high population density for Detroit
- Fatalities and severe injuries occur at a high rate
Major Requirements and User Needs

- Pedestrians need to be able to cross the street safely
- System must be able to communicate roadway conflicts and hazards in real-time to connected vehicles and TMC
- Solutions should be adaptable to the growth in connected and autonomous vehicle (CAV) technologies
ITS Technologies Used in Solution

- Upgraded signal system
- Dedicated Short Range Communications (DSRC)
- Video detection
- In-vehicle sensors and communications devices
Upgraded Signal System

- Upgraded signals at intersections throughout corridors allow signals to adapt to CAVs and pedestrians in real-time
- Monitor and manage signals remotely in a TMC
- Optimize traffic progression through coordination
Dedicated Short Range Communications

- Wireless communications technology that allows data transmission between connected vehicles and
  - Traffic signals
  - Video cameras
  - Other infrastructure
DSRC: Safety Applications

- Basic Safety Messages (BSM)
  - Vehicle motion and position
- Emergency vehicle pre-emption and alert
- At-grade rail crossing alert
Video Detection

- High-resolution video cameras allow for detection of motion information of vehicles, pedestrians, and cyclists.
- Detection information analyzed in real-time:
  - Classify vehicles by type.
Video Detection: Safety Applications

- Pedestrian detection at intersections
  - Detects potential conflict between pedestrians and vehicles
  - Detection of mobility-challenged pedestrians
  - Information can be used to send safety warnings and extend the pedestrian signal phase
In-Vehicle Communication Devices: Safety Applications

- Connected vehicles receive safety warnings and information regarding signal timing, pedestrian conflicts, and traffic data from DSRC units.
- Depending on level of automation, a connected vehicle may slow down or brake after warning is received.
Pedestrian Safety Scenario

Mobility-challenged pedestrian crosses multi-lane arterial

Pedestrian is detected by detection cameras

Video analyzers conclude the pedestrian will be unable to cross the street safely before end of pedestrian signal phase

Signal timing extension communicated to other CAVs and TMC

Flash Don't Walk time length extended so pedestrian can cross safely
Costs & Funding

Costs

<table>
<thead>
<tr>
<th>System</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Total Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video Detection</td>
<td>58</td>
<td>$87,000</td>
<td>$5,046,000</td>
</tr>
<tr>
<td>Upgraded Signal Controllers</td>
<td>58</td>
<td>$8,000</td>
<td>$464,000</td>
</tr>
<tr>
<td>DSRC</td>
<td>58</td>
<td>$17,600</td>
<td>$1,020,800</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>$6,530,800</strong></td>
</tr>
</tbody>
</table>

Source: ITS Costs Database, USDOT

Funding

- Eligible for FHWA Advanced Transportation and Congestion Management Technologies Deployment Program grant
Benefits

- DSRC, video-detection, and connected vehicles combine as an ITS system to improve safety for pedestrians and other roadway users.
- Improved pedestrian safety enhances overall pedestrian comfort, which leads to:
  - Higher pedestrian mode share
  - Less congestion
  - More vibrant streets
- System primes the corridors for future growth in V2V and V2I functionality.
Measuring Project Benefits

Safety
● Reduce pedestrian collisions by 30%
● Reduce average emergency response time by 2 minutes

Efficiency
● Reduce intersection delay by 30%
What’s Next for Detroit?

● 20-minute neighborhoods
  ○ Walkable, range of basic living needs, residential density
● Ford CAV Research & Development campus
  ○ Michigan Central Station
Alignment with State/Local Plans

- Michigan State Transportation Improvement Program
- Southeast Michigan Council of Government’s Regional Transportation Plan
- State Long Range Transportation Plan
Questions?

We would like to acknowledge the following persons for their assistance throughout the TTT:

Dr. Carole Turley Voulgaris, Academic Advisor
Travis Low, Industry Advisor
City of Detroit
Michigan DOT
NOCoE