Overview

Work zones are a major source of non-recurrent congestion. Providing accurate and timely information to motorists regarding travel time and delays is critical and can improve mobility and safety through work zones. The objective of this research is to investigate the capability of various travel time data collection technologies to produce accurate work zone travel time information in real-time. In this effort vehicle detection and travel time data were collected along freeway work zones in Atlanta, Georgia using multiple data collection technologies, including Automated License Plate Recognition (ALPR) Cameras, Bluetooth, RADAR, and high definition video. The collected high definition video footage was post-processed utilizing a proprietary video-processing program developed at Georgia Tech that allows manual entry of vehicle license plate information. The travel times and vehicle count information from the manual video license plate processing are then used as a baseline for comparison against both the ALPR, Bluetooth, and RADAR data results.

Equipment

Bluetooth Technology

Common in many standard devices: cell phones, headsets, GPS, and vehicles.
Each active Bluetooth device constantly transmits a unique MAC (Media Access Control) address: six pairs of two hexadecimal digits separated by colons (e.g., 00:02:72:20:67:2A)
Identify vehicles with Bluetooth devices moving in the traffic stream at separated by colons (e.g., 00:02:72:20:67:2A)
Self locates using GPS and cell signal to report speeds and location

Automatic License Plate Recognition (ALPR) Technology

A system digitally captures vehicle license plate characters
Identify license plate numbers at multiple locations and calculate travel time

RADAR

RADAR captures speeds and calculates travel time between two points
Self locates using GPS and cell signal to report speeds and location

I-285 Data Collection

Vehicle detection and travel time data were collected in a freeway work zone corridor along the northwestern section of Interstate-285 in Atlanta, Georgia on six days in Fall 2012 and one day in Spring 2013
Data was collected at two interchange sites
Bluetooth, ALPR, and RADAR data were collected from side-fire locations
High definition video data was collected from overpass locations

Sample results:

<table>
<thead>
<tr>
<th>Date</th>
<th>Site A</th>
<th>Site B</th>
<th>Length of Data Collection</th>
<th>Direction of Travel</th>
<th>Work Zone?</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-07-12</td>
<td>Paces Ferry Road</td>
<td>Northside Drive</td>
<td>2 hours</td>
<td>EB</td>
<td>No</td>
</tr>
<tr>
<td>09-12-12</td>
<td>Northside Drive</td>
<td>Northside Drive</td>
<td>2 hours</td>
<td>EB</td>
<td>No</td>
</tr>
<tr>
<td>09-14-12</td>
<td>Northside Drive</td>
<td>Roswell Road</td>
<td>2 hours</td>
<td>EB</td>
<td>No</td>
</tr>
<tr>
<td>09-29-12</td>
<td>Northside Drive</td>
<td>Roswell Road</td>
<td>2 hours</td>
<td>EB</td>
<td>No</td>
</tr>
<tr>
<td>10-07-13</td>
<td>Riverside Drive</td>
<td>Paces Ferry Road</td>
<td>3 hours</td>
<td>WB</td>
<td>No</td>
</tr>
</tbody>
</table>

Travel Time Matching

Raw vehicle detection data from Bluetooth and ALPR equipment are matched across the two sites using a travel time matching algorithm
This matching algorithm finds exact matches from all of the equipment data and also finds additional ALPR matches by making all possible plate number combinations for plate reads containing bracketed digits.

Draft Travel Time Results & Discussion

Travel times from the various equipment were compared using travel time plots and Y-Y plots.

Conclusion

Automatic License Plate Recognition (ALPR) cameras, Bluetooth, and RADAR were investigated for their travel time measurement capabilities. ALPR and RADAR presented a potential lane bias issue in congestion while Bluetooth showed a potential bias to slower vehicles. In addition to the importance of data accuracy given the need for fast, temporary deployments, data collection equipment should also have the following characteristics:

- Real-time data reporting
- Quick and Simple Deployment
- Portable power supply
- Low Maintenance

Finally, as all tested technology is point detection based, it is critical that any deployment covers the full extent of anticipated work zone related congested area.

Lane Bias Issue

ALPR

- 73% of all ALPR matches were detected in Lane 4 (the outside lane adjacent to equipment) during October 10th, 2012 data collection.
- Vehicles in lanes further from equipment tended to be occluded.

RADAR

- Similar to ALPR, high travel time spikes suggest primary vehicle detection in lane closest to equipment.
- Low profile may cause it to primarily sense vehicles in the closest lanes.

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