Developing a Portable and Reliable Data Collection System for Evaluating Driver Behavior around Law Enforcement

TRAVIS TERRY

DR. RONALD GIBBONS
Problem

• Police officers are injured in vehicle crashes more than any other aspect of their jobs
  • Between 2003 and 2012, 996 police vehicles were involved in fatal crashes in the U.S.

• Visibility treatments added to the police vehicle serve to enhance visibility; however...
  • There are no general guidelines for lighting or painting a police vehicle
  • Most color schemes and lighting configurations are traditional or personal preference
A Common Occurrence Despite Active Lighting and Retroreflective Markings
Research Goals

• Evaluate the effects of different lighting configurations
  • Observe changes in traffic speed
  • Observe lane change behavior

• Make recommendations for vehicle lighting based on results

• Other variables existed in the full study
  • Paint color, retroreflection, profile and rear concepts
  • This submission focuses primarily on the lighting aspect of the research
Design Method

• Create a naturalistic scenario
  • Virginia State Police vehicle was used to simulate routine traffic stop of a confederate vehicle

• Five or Six (depending on location) Radar and Camera systems used to record traffic data
  • Each system was placed on the shoulder of the roadway
  • Typically 1 to 2 meters from white edge line
  • Distance between systems varied by location
Hardware Method

- Cameras and radars
  - Mounted 25ft high on telescoping poles
  - Operated via tablet and powered by portable battery
  - Each system was standalone and anchored down with sandbags
- GoPro Camera mounted on plate atop SMS Radar System
Hardware Method

SMS Radar
- Intended to be mounted to vehicles for collision monitoring
- Utilizes 12 volts for power and communicates via CAN bus
- Communication with radars took place through custom Labview software
- Radars used primarily for speed, not lane position

GoPro Cameras
- Used primarily for determining lane position
- Camera models included Hero 3+ and Hero
Setup Method

- VSP provided a buffer for equipment crew on setup and take down to provide safety and visibility
- Setup took approximately 30 minutes and take down approximately 15 minutes
- The data recording sessions lasted between 15 minutes to 75 minutes depending on location
  - 100 vehicles or
  - 15 minutes
## Locations

<table>
<thead>
<tr>
<th>Roadway</th>
<th>Location</th>
<th>Traffic Density</th>
<th>Lanes</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route 11</td>
<td>Shawsville, VA</td>
<td>Low – 80/hr</td>
<td>4 – Divided</td>
<td>60 MPH</td>
</tr>
<tr>
<td>460</td>
<td>Blacksburg, VA</td>
<td>Medium – 400/hr</td>
<td>4 – Divided</td>
<td>65 MPH</td>
</tr>
<tr>
<td>Prince William Parkway</td>
<td>Manassas, VA</td>
<td>High – 900/hr</td>
<td>4 – Divided, Stop Controlled</td>
<td>55 MPH</td>
</tr>
<tr>
<td>Interstate 81</td>
<td>Christiansburg, VA</td>
<td>High – 900/hr</td>
<td>4 – Divided</td>
<td>70 MPH</td>
</tr>
<tr>
<td>Interstate 66</td>
<td>Fairfax, VA</td>
<td>Very High – 4800/hr</td>
<td>8 – Divided</td>
<td>55 MPH</td>
</tr>
</tbody>
</table>
Baseline
Baseline + Red

• Added red to standard light bar
• One half red, one half blue
Max Lighting

• Additional blue lights to standard light bar
• Lights below side mirrors and to rear license plate
• Light to vehicle sides (near front wheel)
Minimal Light

• Replace all lighting with single blue “cherry-top” beacon
Data

Percent of Lane Change to Far Lane
I-81 South, Night

Speed Change,
I-81 South, Night
Early Results

• Addition of red to light bar improved reaction time in day time conditions over all blue light bar

• Max light conditions resulted in early merges and slower speeds

• Lack of response with Beacon indicates intensity is important – lights should not be removed from standard configuration
Further Testing and Considerations

• Combination of red and blue and max lighting configurations
  • Field Operations Test – Phase 2
  • Deploy 50 to 100 VSP vehicles with new concept configurations and rely on self report data of collision and near misses

• Explore visibility of Troopers/Officers in proximity to vehicle
  • Especially in Max Light conditions (Glare?)

• Explore glare impact of Troopers/Officers in pursuit; i.e. following another actively lighted pursuit vehicle
Summary

• The naturalistic testing procedure allowed for practical recommendations of lighting configurations

• Portability of systems allowed them to be setup and maneuvered in a number of locations and settings

• Systems operated individually and did not require a network or external power

• Non-Invasive implementation allowed for traffic to pass normally through setup location (with buffer VSP vehicle)

• System deemed a success and project results indicate that safety can be increased based on the findings
Acknowledgements

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