Work Zone Safety Using Emerging Technologies

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Department of Civil, Construction and Environmental Engineering
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Agenda
- Review research objective and scope
- Discuss research methodology
- Present research results and findings
- Detail implementation plan

Introduction
- Safety concepts are often taught but not effectively implemented nor practiced
- Current practices do not account for accident causation
- Current practices do not pro-actively protect or warn of potential hazards

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Work Zone Fatalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>12</td>
</tr>
<tr>
<td>2012</td>
<td>9</td>
</tr>
<tr>
<td>2011-2003</td>
<td>25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2014 Alabama Work Zone Crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
</tr>
<tr>
<td>Fatality</td>
</tr>
<tr>
<td>Unknown</td>
</tr>
<tr>
<td>Injury</td>
</tr>
<tr>
<td>Property Damage</td>
</tr>
</tbody>
</table>

How Do We Protect Workers?

Objective: Investigate and evaluate commercially-available technologies thought to enhance safety in highway work zones.

Research Methods

Technology Review

<table>
<thead>
<tr>
<th>Technology</th>
<th>Limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS</td>
<td>Not functional under overhead obstructions / expensive</td>
</tr>
<tr>
<td>Laser</td>
<td>Not capable of identifying people vs. objects</td>
</tr>
<tr>
<td>Radar</td>
<td>Not capable of identifying people vs. objects</td>
</tr>
<tr>
<td>UWB</td>
<td>Sizable amount of infrastructure / expensive</td>
</tr>
<tr>
<td>Sonar</td>
<td>Low read range (max 10 m)</td>
</tr>
<tr>
<td>Video</td>
<td>Poor visibility at night or in dusty areas</td>
</tr>
</tbody>
</table>
Key Evaluation Metrics

- Read range (maximum and minimum)
- Reliability of alert range (false positives)
- Data processing effort
- User-interface
- Signal strength and security
- Feasibility to function in the work zone environment
- Required assembly and mounting positions
- Alert method (audible, visual or vibratory)
- Cost
- Power source

Technology Review

<table>
<thead>
<tr>
<th>System Type</th>
<th>Intrusion Technology</th>
<th>States Tested</th>
<th>Alert Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinematic</td>
<td>SonoBlaster</td>
<td>New Jersey DOT (Krupa 2010), Kansas DOT (Novosel 2016)</td>
<td>Audible</td>
</tr>
<tr>
<td>Pneumatic and Microwave</td>
<td>Traffic Guard Worker Alert System</td>
<td>None</td>
<td>Yes, No, No</td>
</tr>
<tr>
<td>Radio-Based</td>
<td>Intellicone</td>
<td>Kansas DOT (Novosel 2016)</td>
<td>Audible, Visual, Vibratory</td>
</tr>
</tbody>
</table>

Kinematic (SonoBlaster)

- Audible alert
- Passive
- Unable to detect vehicle vs. objects

Pneumatic (Traffic Guard Worker Alert System)

Radio-Based (Intellicone)

Radar-Based (AWARE System)
Preliminary Trials

Experimental Set-Up and Data Collection

Experimental Set-Up and Data Collection

Experimental Trials

Sound Level of Intellicone and Traffic Guard

Results of Worker’s Reaction Time
Results of Vehicle Stopping Time

Recommendation for Implementation

- **Intellicone** for extended tapers with longer term temporary traffic control devices
- **Traffic Guard Worker Alert System** for shorter tapers and short term work zone operations
- **AWARE** for mobile operations

Conclusions

- Current safety practices for highway work zones are **inadequate**
- Technology can provide an **additional layer of safety protection** for personnel in work zones
- Commercially-available technologies can enhance safety performance of workers in work zones
- Scientific evaluation of these systems is necessary to identify benefits and limitations
- Worker and operator safety performance measurement, training and education becomes possible

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