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<b>UTC Project Information</b>	
Project Title	Smart Work Zone System
University	Virginia Tech
Principal Investigator	Mike Mollenhauer
PI Contact Information	<a href="mailto:mmollenhauer@vtti.vt.edu">mmollenhauer@vtti.vt.edu</a>
Funding Source(s) and Amounts Provided (by each agency or organization)	Safe-D (Federal): \$150,000 Matching fund (Non-Federal): VDOT/VTRC: \$150,000 (combination of in-kind and cash)
Total Project Cost	\$300,000
Agency ID or Contract Number	Project: VTTI-00-036
Start and End Dates	04/01/2021 – 08/30/2021
Brief Description of Research Project	The Smart Work Zone System project aims to design and deploy a complete package supporting C-V2X technology and wireless communications to warn both connected vehicles (CVs) and workers about their presence or non-safe scenario inside a work zone. The system consists in three key pieces which will allow communications between vehicles and workers: a C-V2X/4G base station, Smart Vest component as wearable device to track and provide warnings to the workers and the Smart Cone which will be a device to create a virtual geo-fence and provide lightning capabilities around the work zone deployment.
Describe Implementation of Research Outcomes (or why not implemented)  Place Any Photos Here	<p>Device Design and Development:</p> <ul style="list-style-type: none"> <li>- Smart Vest Wearable Device. This project will procure another design iteration to improve the current design and optimize it for field use. The goal is to build a light-weight, ruggedized and protected system that can be attach to a Class 3 Work Zone vest with minimal effort.</li> <li>- Smart Work Zone Base Station. This device will provide the wireless link between Connected Vehicles (CVs) and workers by using a C-V2X/4G RSU and wireless communications between the Smart Vest nodes and itself. The base station will process the GPS information from all the Smart Vest nodes and convert it into SAE J2735 PSM messages which will be broadcasted over C-V2X and</li> </ul>

	<p>forwarded to VCC Cloud Server. Also, the base station will receive SAE J2735 BSM messages from CVs and will use them internally to generate HMI warnings to the workers when necessary.</p> <ul style="list-style-type: none"> <li>- Smart Cone. This device will be used to create a virtual fence by locating several units on the work zone border. Additionally, this device will have a LED based lighting capabilities allowing to be used for work zone signaling using pre-created patterns.</li> <li>- Mobile Smart Base Station. This system will allow law enforcement and emergency vehicle personnel to receive warnings when they are assisting near vehicle traffic on urban or highway areas. The system incorporates a radar and camera that will detect when a vehicle is approaching near or to the adjacent lane and will generate a HMI warning transmitted to the Smart Vest devices in close range.</li> </ul> <p>Additional activities:</p> <ul style="list-style-type: none"> <li>- System testing on real work zone deployment for performance and usability.</li> <li>- Smart Vest Design IP filling with VTIP</li> <li>- Final System demonstration including Vehicle and workers in the setup.</li> </ul>
<p>Impacts/Benefits of Implementation (actual, not anticipated)</p>	<ul style="list-style-type: none"> <li>- Improve safety conditions for workers in roadside work zones.</li> <li>- Provide feedback to CVs when approaching to work zones and there are workers present.</li> <li>- Improve the usage and comfort of the Smart Vest allowing to be worn for long shifts.</li> <li>- Maximize the number of uses cases supported by the system by using different technologies such as C-V2X, 4G, BLE and targeting not only workers but other personnel such law enforcement and emergency vehicle teams.</li> </ul>
<p>Web Links</p> <ul style="list-style-type: none"> <li>• Reports</li> <li>• Project website</li> </ul>	<p><a href="https://safed.vtti.vt.edu/projects/smart-work-zone-system%e2%80%8b/">https://safed.vtti.vt.edu/projects/smart-work-zone-system%e2%80%8b/</a></p>