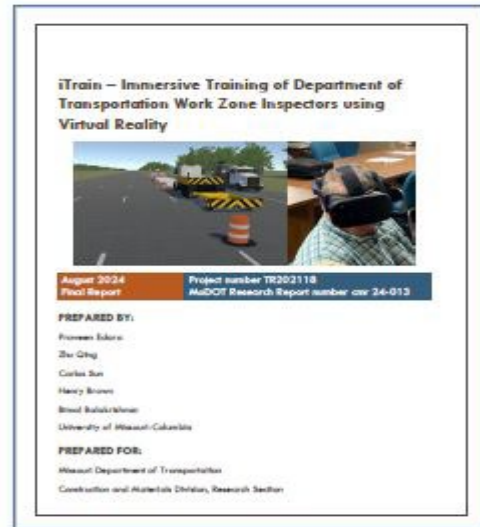# Research Summary

iTrain – Immersive Training of Department of Transportation Work Zone Inspectors using Virtual Reality

The iTrain project, in collaboration with the Missouri Department of Transportation (MoDOT), aimed to enhance work zone safety training of MoDOT staff through the development and implementation of virtual reality (VR) training modules. These modules were designed to provide immersive, realistic, and interactive scenarios to enhance knowledge retention, engagement, and practical skills application in work zone training courses.

The development process of immersive training scenarios is outlined in this report and includes the following steps: texture creation, 3D-model development, interaction programming, and user interface design. VR modules were developed targeting two MoDOT work zone training courses: Advanced Work Zone Training and Flagger Training.

In the Advanced Work Zone Training course, two VR modules were developed. The first VR module focused on learning work zone typical applications by providing participants with an immersive drive through VR experience. The second VR module concentrated on helping participants practice identifying deficiencies within work zones through various scenarios. A comparison test, a call-out practice, and a post-training survey were incorporated to gather information of participant learning, perceived realism, and overall effectiveness. The results from 147 participants from six separate trainings showed that 86.8% of participants agreed that the VR module was realistic and 85.1% agreed that VR is useful for training staff.

> *"The VR training modules developed … have proven to be effective tools for enhancing work zone safety training."*

In the Flagger Training course (Figure 1), the VR module emphasized hands-on practice of the 3-2-1 Cone Procedures. Participants' ability to perform flagging operations was tracked and evaluated using developed behavioral measures. Additionally, a post-training survey was conducted to obtain feedback on VR module usability, user engagement level, and training effectiveness. The industry standard system usability scale (SUS) score of 78.4 demonstrated the usability of the VR flagger module.

Post-training surveys indicated high satisfaction levels, with participants appreciating the realistic work zone representations, ease of use, and overall effectiveness of the VR modules. Behavioral measures demonstrated participants' ability to effectively identify deficiencies and

perform flagging operations, capabilities not feasible with traditional training methods. Hands-on demonstrations and outreach activities confirmed the positive reception of the VR training modules and highlighted their potential for broader adoption across other DOTs and agencies. Nine outreach events were conducted as part of national and regional conferences and workshops, including Washington, D.C., Illinois, Indiana, North Dakota, and Iowa. The survey results showed that 95.8% agreed that VR was realistic, 94.4% agreed that VR was easy to use, 98.6% agreed that VR was effective, and 86.1% expressed a desire to include VR in future training at their agency.

In summary, the VR training modules developed through the iTrain project have proven to be effective tools for enhancing work zone safety training. The integration of advanced VR technology offers a promising approach to supplementing traditional methods and providing a more immersive, interactive, and effective training experience. The developed VR modules are intended for continued use in MoDOT training. The flexibility of VR training allows it to meet a variety of needs, staff backgrounds, and makes it suitable for different training purposes. Future efforts will focus on expanding VR scenarios, incorporating feedback for future development, and exploring new applications of VR technology in transportation safety training.

Figure 1: VR flagger training scenario and participant.

Project Information

PROJECT NAME: TR202118—iTrain – Immersive Training of Department of Transportation Work Zone Inspectors using Virtual Reality

PROJECT START/END DATE: August 2021-July 2024

PROJECT COST: $460,238

LEAD CONTRACTOR: University of Missouri-Columbia

PRINCIPAL INVESTIGATOR: Praveen Edara, Ph.D., P.E., PTOE

REPORT NAME: iTrain – Immersive Training of Department of Transportation Work Zone Inspectors using Virtual Reality

REPORT NUMBER: cmr 24-013

REPORT DATE: August 2024

Project Manager

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