Using Augmented 360-Degree Panoramas of Reality for Construction Safety Training

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In an attempt to lessen the adverse effects of construction practices on the environment and human health, many Research has found that construction-safety training yields low levels of engagement, which diminishes the benefit of these interventions. Alternatively, scholars have presented virtual reality (VR) as a method to increase safety- related knowledge retention. Nevertheless, using VR to represent complex simulations of the real-world is currently very computationally intensive and time consuming. Although 3D computer graphics allow users to synthesize an environment for arbitrary representations, realism is often constrained by the rendering quality and scene complexity. To address these limitations, 360-degree panoramas of reality have been used in recent research studies to provide immersive representations of construction jobsites for safety-training purposes. This research utilizes 360-degree panoramas of reality with layers of augmented information and defined a graphical user interface that is conducive for improving workers' hazard-identification skills within the complex context of real construction projects. These low-cost, simple-to-capture representations of real settings provide unbroken views of a whole region surrounding an observer, thereby allowing for an interactive look-around experience with a strong sense of presence. Within the platform, trainees actively practice identifying hazards in a highly engaging and realistic environment.

The objective of this research is to develop and validate a method to augment 360-degree panoramas and define a user interface that is conducive for trainee hazard identification skills within complex context of real construction projects. To achieve this, trainees explored the virtual environment under three different session: (1) a training or content learning session, (2) an assessment or knowledge testing session, and (3) a feedback or review of knowledge session A platform was developed using panoramas of reality to provide a method for safety training (PARS); specifically, to improve hazard identification skills through interactive practice within complex context of real construction projects. To assess the capabilities of PARS to deliver an interactive practice for trainees to identifying hazards in realistic jobsites, the hazard identification index (number of hazards identified by the trainee divided by the total number of identifiable) scores were collected from 30 users during the assessment session.

Additionally, the user feedback was collected utilizing surveys and questionnaire tools to obtain the perspectives from the trainees regarding the usability of the platform and how satisfied they were with the overall experience. The findings of this research showed that hazards were identified by the training participants in an average of 30%. Constructive feedback was obtained concerning the usability of the platform. The study participants stated in general that the platform was easy to use, easy to learn how to operate, and noted that on screen augmentations aided them to locate the hazards in the panoramic scenes. However, the participants expressed that numerous enhancements need to be attended in the platform to improve the experience, specifically indicating that the time limits posed on the assessment session were too short. The contribution of this research is to present an alternative method for practicing hazard identification using 360-degree panoramas of the actual construction jobsite, thereby enabling training opportunities that better train users to recognize four sample types of hazards. This would ultimately lead to a safer jobsite as trainees become aware of potential hazards.

Keywords: 360-Degree Panoramas, Mixed Reality, Reality Capture