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Abstract. The failure to identify unsafe conditions has been considered a major contributing factor to construction accidents. Augmented Reality (AR) goggles have emerged as promising devices for warning onsite workers of potential hazards using dynamic visual stimuli. However, there is a lack of methods available to quantify the impact of AR warnings on construction workers, hindering the evaluation, improvement, and promotion of warning systems. To address this gap, a method to measure the impact was developed in this study. Six metrics were designed to quantify the performance of system users under the impact of AR warnings. Next, a

evaluated the impact of in-vehicle visual support on construction equipment operators using eye-tracking glasses. Despite the proven benefits of eye-tracking in evaluating digital systems, applying eye-tracking techniques to measure the effectiveness of wearable AR systems has not received sufficient attention. Therefore, this study aims to develop a quantitative approach to measure the impact of AR warnings on onsite construction workers using eye-tracking technology. The article is organised as follows: Section 2 reviews the onsite safety warning systems and corresponding evaluation methods, as well as the application of eye-tracking in the construction safety area. Section 3 introduces the research methodology. Section 4 presents and discusses the results of a case study. Finally, the paper is concluded in Section 5.

2. Literature Review

2.1 Safety Warning Systems and Evaluation Methods

With the incorporation of more technology, safety warning systems offer multimodality to help onsite workers obtain hazard information

Such simplification does not consider the holistic decision-making process of workers in complex construction scenarios. Wu et al. (2022) integrated Building Information Modelling (BIM) into an AR warning system that allows AR devices to provide warnings of multiple hazards, including explosions, falling from heights, and struck-by accidents. In their system, users can literally see the surrounding hazard areas with annotations in the real world. Their experiments only focused on the feasibility of their concept and paid no attention to the impact of the visual warnings on users. While the immersive AR experience provides users with hazard information in a natural and intelligent manner, it places a higher demand on the usability evaluation. First, because AR holograms are merged with the construction environment, workers can obtain AR prompts while scanning the environment. The act of obtaining AR prompts is natural and difficult to be captured. Second, the visual representation of AR prompts varies with the relative position between the worker and the hazard source. The effect of this variation on worker performance is difficult to quantify. Finally, the experiment involved a

Physiological indicators	Pupil size	The average diameter of pupils within a certain period of time
	Blink frequency	

3. Methodology

3.1 M

materials, pipe laying, formwork, rebar tying, and other works. Workers were required to perform these tasks while ensuring their own safety. The AR goggles deployed two types of warnings, namely, AR visual warnings developed by Wu et al. (2022) and beeping alarms proposed by Teizer (2015).

	5	Struck-by	-	482.02	3265.19	3446.10	7193.31
Auditory	6	Exploration	-				

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