2024-25 HIVE Summer Internship Project

Using AR Visualisation for Construction Safety Training

11FBL_MM_ConstructionSafetyAR

Primary Academic Supervisor
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Project Background

Safety training on construction sites prevents accidents and ensures worker well-being. In Australia, the construction industry accounted for 22% of all workplace fatalities in 2018 despite only employing around 9% of the workforce, emphasising the critical need for effective safety training (Safe Work Australia, 2018). Similarly, in Hong Kong, the construction industry has a significantly higher accident rate than other industries. Initiatives like the Safe Working Cycle, which includes regular safety briefings and checks, have helped reduce accidents. This underscores the importance of consistent safety training and monitoring (Chan & Aghimien, 2022). Mandatory safety training courses have been effective, with participants reporting increased safety awareness and behaviour (Tam & Fung, 2012). However, while safety training improved knowledge and behavioural intentions in Australia, it did not significantly change attitudes. This highlights the urgent need for more comprehensive programs to address all safety aspects (Loosemore & Malouf, 2019). Augmented reality (AR) has the potential to revolutionise construction site safety training by enhancing learning efficiency and on-site safety. AR overlays digital data onto the physical world, creating immersive scenarios replicating real site conditions. This allows workers to practise safety protocols in a controlled yet realistic setting. AR vividly illustrates potential hazards and safe practices through 3D models and simulations, improving hazard identification and memory of safety procedures. This practical approach enhances understanding of spatial relationships and potential risks on site, reducing the likelihood of accidents.The technology also provides real-time guidance and information to workers, such as displaying safety equipment locations, detailing step-by-step procedures for complex tasks, and alerting workers to nearby hazards. This just-in-time information delivery can significantly reduce human err

Project Description, Expected Outputs, Possible Stretch Goals

Virtual reality (VR) fully immerses users in a digital environment, while augmented reality (AR) overlays digital elements in the real world. VR technology has been widely adopted because it offers simulated environments where workers can practise scenarios without real-world risks. VR training programs often include modules on equipment operation, hazard identification, and emergency response, making it an effective and reassuring solution for safety training in the construction industry. On the other hand, AR is a technology that is still emerging in construction safety training. It has the potential to provide contextual information and real-time guidance on representations of actual job sites, but its current use in comprehensive safety training is limited. In fact, the existing AR applications in construction primarily focus on providing on-site information, such as equipment locations or project visualisations, rather than full-fledged safety training programs. This suggests that developing robust AR safety training solutions has significant growth potential, offering a promising future for safety training in the construction industry. Currently, Construction Council Industry Council (Hong Kong) has developed a virtual reality training for: (1) confined spaces and working at height and (2) heavy machinery and lifting operation. The aim of the proposed internship project is to use the existing VR material as a reference and create an AR visualisation proof-of-concept (POC) on Tilt Five. Construction Council Industry Council (Hong Kong) will provide expert knowledge and advice on the scenario being created and visualised in the AR POC. Beyond creating the POC, The stretch goal of the project is to track the interaction of the user within the AR environment so to the ascertain the effectiveness of the AR training POC.

Links to background reading and any relevant recent work in the field

- Li, X., Yi, W., Chi, H. L., Wang, X., & Chan, A. P. (2018). A critical review of virtual and augmented reality (VR/AR) applications in construction safety. Automation in construction, 86, 150-162. - Man, S. S., Wen, H., & So, B. C. L. (2023). Are virtual reality applications effective for construction safety training and education? A systematic review and meta-analysis. Journal of safety research. - Ahmed, S. (2018). A review on using opportunities of augmented reality and virtual reality in construction project management. Organization, technology & management in construction: an international journal, 10(1), 1839-1852.

What type of visualisation will the student develop or produce?
AR is a technology that is still emerging in construction safety training. It has the potential to provide contextual information and real-time guidance on actual job sites, but its current use in comprehensive safety training is limited. Thus, the proposed internship will use existing VR training material developed by Construction Council Industry Council (Hong Kong) as a reference and develop a AR proof-of-concept (POC) on Tilt Five. Construction Council Industry Council (Hong Kong) will provi

How will the visualisation contribute to your research outcomes?
To assess the effectiveness of safety training on construction sites, we propose an experiment comparing three different training modalities: traditional computer-based training (CBT), virtual reality (VR), and augmented reality (AR). This experiment is crucial in understanding which modality is most effective in enhancing construction site safety knowledge and skills. In order to conduct the research, we will need to develop the AR stimulus which is the aim of this proposed internship.

If the project is successful, where would you consider publishing the results?
Journal of Safety Research (SJR Q1 and 4.86 IF)

Draft Project Timeline:

Week 1
Project onboarding and meeting with industry partner

Week 2
Review of existing materials of Construction Industry Council

Week 3
Review of technical requirement and feasibility

Week 4
Creation of AR visualisation POC - week 1

Week 5
Creation of AR visualisation POC - week 2

Week 6
Trial and industry partner feedback

Week 7
Enhancement of POC - week 1

Week 8
Enhancement of POC - week 2

Week 9
Report writing and co-creation of presentation with industry partner

Week 10
Report writing and co-creation of presentation with industry partner

Student Experience and Supervision:

How often will you meet with the student over the 10-week period?

Twice per week (Monday and Wednesday)

Your work desk location and the location of student desk

Curtin HIVE 407.211 (Consumer Research Lab) 407.803 (Billy's Office)

Student Attributes:

Please indicate any preference for student's academic discipline or field of study

Computer science

What competencies are required to start this project

Advanced - 2D image and/or video software (e.g. Adobe Suite, Sony Vegas)
Advanced - 3D modelling software (e.g. Blender, 3ds Max)
Beginner - Unity 2D/3D Artistry (assets, lighting, cameras, materials implementation)
Advanced - Unity Programming (C# coding, animation syntax, debugging, problem-solving)
Intermediate - Unity Virtual Reality Development (rendering pipelines, scene content design, interaction)

Do you have any other student attributes you think are important to the project?

Not applicable