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Visualizing Energy Use: Development of an Augmented Reality-based Training System for Sustainable Living Education

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Abstract:

The urgent need for sustainable energy practices has become increasingly clear in the face of global environmental challenges, with building sectors being a significant contributor to energy consumption and carbon emissions. This necessitates innovative approaches to reduce energy consumption and carbon emissions in the building sectors. There are two major approaches to achieving this objective: adopting energy-efficient approaches for building design and operation and changing occupants' behavior in the building operation. Both approaches require the users and construction practitioners to understand the building energy consumption and associated carbon emission intuitively for the current situations and scenarios. This project proposes developing an Augmented Reality (AR) and Internet of Things (IoT) based interactive system to visualize energy consumption and carbon emission, using Hong Kong's institutional buildings as an example. By tangibly demonstrating abstract energy and carbon emission concepts, it aims to enhance learning experiences and actively encourage sustainable behaviors by showing the immediate impact of actions to be taken. Aligned with Hong Kong's smart city and energy conservation policies, this system emphasizes interdisciplinary learning, technological fluency, and personal responsibility for the environment. By enabling student participation in the design, implementation, and evaluation, it stimulates ownership and motivates behavioral change. To comprehensively evaluate impact, the project assesses learning performance through interactive assessments, project-based learning, portfolios, peer/self-reviews, AR-IoT analytics, surveys, and interviews. If successful in making energy usage and carbon emission tangibly understandable and actionable, the AR system will be integrated into the teaching curriculum of several undergraduate courses (CA2418 Green Building and Construction, CA3168 Building Information Modelling for Capital Projects, and CA4423 Sustainable Green Construction). This project can revolutionize Hong Kong's educational approaches towards energy conservation and carbon emission by embedding discovery and innovation in the curriculum while preparing students for future sustainability challenges.