


Chapter 8

Artificial Intelligence, Virtual Reality, and Augmented Reality to Enhance Visual Quality and Accessibility in Sustainable Built Environments

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ABSTRACT

Artificial intelligence (AI), virtual reality (VR), augmented reality (AR), and smart home technologies can enhance visual quality, functionality, and inclusion in built environments. AI algorithms are essential for refining lighting models, strengthening natural lighting, energy efficiency, and sustainability. VR provides immersive experiences in architectural and environmental planning, as well as in cultural heritage preservation and architectural education. Integrating VR with Building Information Modeling (BIM) platforms improves visualization and interaction in sustainable building design. Additionally, AR and smart home systems offer real-time information on space design, enhancing accessibility and efficiency, especially for

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people with disabilities. AR can also assist in assessing building safety and predicting disasters. This combination of technologies optimizes architectural design, lighting, and space distribution, promoting attractive, functional, and inclusive environments that enhance the well-being and quality of life of all people.

INTRODUCTION

Visual quality and accessibility are essential components of the sustainability of built environments. Both aspects promote inclusion, longevity, efficiency, and legal compliance, contributing to the creation of more resilient, equitable, and livable communities for all. Visual quality refers to the subjective and objective perception of the visual attributes of an environment or object. It encompasses elements such as aesthetic design, visual harmony, lighting, color, texture, and composition. In the context of built environments, visual quality relates to the aesthetics of buildings, spatial distribution, integration of natural and artificial elements, and how these aspects influence the visual and emotional experience of individuals occupying these spaces. High visual quality can contribute to a satisfying and comfortable experience, while low visual quality may result in discomfort, visual fatigue, or aesthetic dissatisfaction.

Conversely, accessibility is crucial to ensure that built environments are usable by all individuals, regardless of their physical abilities. This promotes social inclusion and equity by enabling everyone to actively participate in community life and have equal opportunities to access services, employment, education, and recreation. Furthermore, accessible environments are more adaptable to the changing needs of the population over time, making them more sustainable in the long term. This is especially important in the context of an aging population, where older individuals may experience mobility or vision difficulties.

Accessibility also contributes to the efficiency and utility of built environments by making them more accessible to all users, not just those with disabilities. For example, a ramp not only benefits wheelchair users but also parents with baby strollers, elderly individuals with shopping carts, and even those carrying heavy luggage. Additionally, complying with accessibility standards and regulations is a legal obligation in many countries, demonstrating a commitment to equity and human rights principles.

Visual quality and accessibility are pivotal aspects that underpin the sustainability of built environments, encapsulating not only their aesthetic allure but also their functional efficiency and inclusivity. The intricate interplay between human users and their built surroundings emerges as a critical determinant shaping the overall quality and experience of built environments (Goh, 2022). Indeed, the significance

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