

Chapter 13

Augmented Reality Research for Architecture and Design

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ABSTRACT

A growing body of research has shown that Augmented Reality (AR) has the potential to contribute to interaction and visualization for architecture and design. While this emerging technology has only been developed for the past decade, numerous journals and conferences in architecture and design have published articles related to AR. This chapter reviews 44 articles on AR especially related to the architecture and design area that were published from 2005 to 2011. Further, this chapter discusses the representative AR research works in terms of four aspects: AR concept, AR implementation, AR evaluation, and AR industry adoption. The chapter draws conclusions about major findings, research issues, and future research directions through the review results. This chapter will be a basis for future research of AR in architecture and design areas.

INTRODUCTION

During the last two decades, the Architecture/Engineering/Construction (AEC) domain, which heavily relies on visualization, has significant benefited from Virtual Reality (VR) technology. VR

is a technology to simulate a computer-generated world and the potential of virtual visualization has captured the AEC industry's attention. Recently, by enriching interaction techniques and by overcoming the lack of the integration with a real environment, a new emerging technology Augmented Reality (AR) has entered our daily life and world. In the line of the Reality-Virtuality

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continuum (Milgram and Kishino 1994), AR is characterized by the combination of the real and virtual, real time interaction, and registration in 3D (Azuma 1997). The technological advancements of AR have clearly shown the significant sophistication of technological capabilities.

Although the concept of AR is as simple as the idea of mixing the real and virtual worlds, the AR research agenda in architecture and design ranges from its concept generation to industrial adoption. AR involves the human perception with both real and virtual information sources, and accordingly, AR research in architecture and design is an inter-disciplinary research between the AR technology, human factors, and design. The enabling technologies of AR consist of media representations, interaction devices, feedback displays, trackers and computing units. More varied media representations are utilized in AR than VR, where input and output mechanism is considered for object manipulation in the augmented digital information onto a real background. Further, human factor studies are necessary not only in the rigorous methodology, but also in the application of the technology to a targeted domain in which researchers are conducting critical evaluation and validation.

A growing body of research has shown that AR has the potential to contribute to interaction and visualization for architecture and design. The hybrid visualization afforded by AR can potentially impact on the architecture and design practice by changing the way people experience and interact. While this emerging technology has been mainly advanced during the past decade, numerous journals and conferences in architecture and design have published articles related to AR. The current research identified a total of 44 main articles on AR that are especially related to the architecture and design area. They were published from 2005 to 2011. Furthermore, this chapter discusses the representative AR research works in terms of four aspects: AR concept, AR implementation, AR evaluation and AR industry adoption. This

chapter also draws conclusions regarding major findings, research issues, and future research directions through the review results.

The research work in AR has ranged from the conceptual framework to lab-based prototype proof, evaluation, and case illustration. It is necessary to have a comprehensive review of recent significant AR applications in architecture and design, in order to provide a comprehensive understanding of the state-of-the-art work in the field and its impact on architecture and design. Each paper was reviewed by the authors to determine its eligibility and level of relevance. Only current articles published from 2005 to 2011 were considered, with the aim of focusing on the most recent advances. The selected paper had to be AR works in the areas of architecture and design. Considering AR for design is an emerging area, thus both the leading international journals and conferences were searched. The identification of articles involved keyword searches as well as careful examination of the titles of articles. The search was initialized using the keyword combination with one expression chosen from “augmented”, “augmented reality”, “mixed” and “mixed reality”, and one chosen from “architecture”, “design”, and “digital architecture”. Articles that appeared to fit into the category were verified by first reading the abstract and then the entire article to extract the main findings. Many articles that were initially identified via the title or keywords were discarded in the screening process. In the end, only 44 key articles were determined for the content analysis as being associated with architecture and design.

AUGMENTED REALITY RESEARCH IN ARCHITECTURE AND DESIGN

The general characteristics of AR research in architecture and design were identified first. Then the more specific results were reported, along with research issues that emerged through the review of the AR works.

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