

# Creating Adaptive AR Gaming Experiences: Intelligent Systems for Better Integration and Interaction of Real and Virtual World

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## Abstract

Creating immersive AR gaming experiences requires seamless integration between virtual content and real-world environments. However, the diverse and unpredictable nature of user (player) environments poses significant challenges in delivering consistent and natural gaming experiences. This work presents intelligent systems that can provide adaptive AR gaming experiences across various real-world settings. The key of an immersive AR gaming experiences lies in two critical aspects: natural interaction between virtual character and real environments, and adaptive integration of game content into user's physical spaces.

Firstly, a novel framework that enables virtual characters to interact intelligently with real environments is proposed. Traditional AR systems mainly focus on geometric and illumination consistency, which proves insufficient for dynamic virtual character interaction. This framework combines SLAM-based geometric understanding with semantic segmentation, allowing virtual characters to perceive and respond to their surroundings meaningfully. It introduces object-class-behavior matching and rule-based object selection mechanisms that establish flexible relationships between virtual character actions and real-world objects, significantly simplifying the design process while enabling more natural interactions.

Then a visual authoring system for creating adaptive AR game experiences is presented. Through a graph-based template interface and novel scene integration algorithm, designers can efficiently transform their creative vision into deployable experiences without extensive technical expertise. The system automatically analyzes real environments and maps design intentions to available spaces and objects, ensuring consistent game experiences across different settings.

Experiment results demonstrate the effectiveness of both approaches in improving AR interactions. The virtual character framework enables more natural and context-aware behaviors, while the game scene creation system significantly reduces development complexity while maintaining design intention across diverse environments. This work advances the field of AR game design by enabling more adaptive and interactive experiences that seamlessly blend virtual content with real-world environments.