Chapter X

The Evolution of a Framework for Mixed Reality Experiences

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Abstract

This chapter describes the evolution of a software system specifically designed to support the creation and delivery of mixed reality (MR) experiences. We first describe some of the attributes required of such a system. We then present a series of MR experiences that we have developed over the last four years, with companion sections on lessons learned and lessons applied. We conclude with several sample scripts that one might write to create experiences within the current version of this system. The authors’ goals are to show the readers the unique challenges in developing an MR system for multimodal, multi-sensory experiences and to demonstrate how developing MR applications informs the evolution of such a framework. “Making Memories of a Lifetime,” (Chapter XVI), is the creative content companion piece.
Introduction

Mixed reality (MR) presents unique challenges in its requirement to seamlessly integrate interacting virtual objects, audio landscapes, visual presentations, haptic feedback, and show-control devices with real world objects such as human participants, props, and physical settings. In this chapter, we describe the evolution of our MR framework. The key connections between each section are the lessons we learned along the way while developing ever more complex and diverse applications of MR. We also emphasize the system’s flexibility in its design (components can be distributed or aggregated as appropriate for a given scenario’s needs); its provisions for all modes of MR (ranging from physical reality to augmented reality to augmented virtuality to pure virtual reality); its support for diverse modes of experiencing MR (ranging from video-see through head-mounted displays to vision domes to desktop systems, and from unaltered physical environments to theatrical sets to unidirectional retro-reflective “caves”); its openness (all components not developed in our lab are from the open source community); its modularity (its plug-in architecture can accommodate other network protocols, new physics engines, new user interfaces, new interaction devices, new authoring interfaces and new AI components); and its adaptability (we added the concept of story-based rendering in one evening). Our framework has been field-tested with installations for entertainment, free-choice learning, training, and cognitive rehabilitation. Each such application has revealed strengths and exposed weaknesses that informed our evolving design and implementation, and influenced our program of basic research.

The central component of the MR framework is the MR story engine (SE), a container for software agents (actors): one for every user, virtual object and real object that interacts with other agents; one for communication with the underlying system; zero or more to maintain the story line; and zero or more to support abstractions. The software agents manage the