MR360 Interactive: Playing with Digital Creatures in 360° Videos

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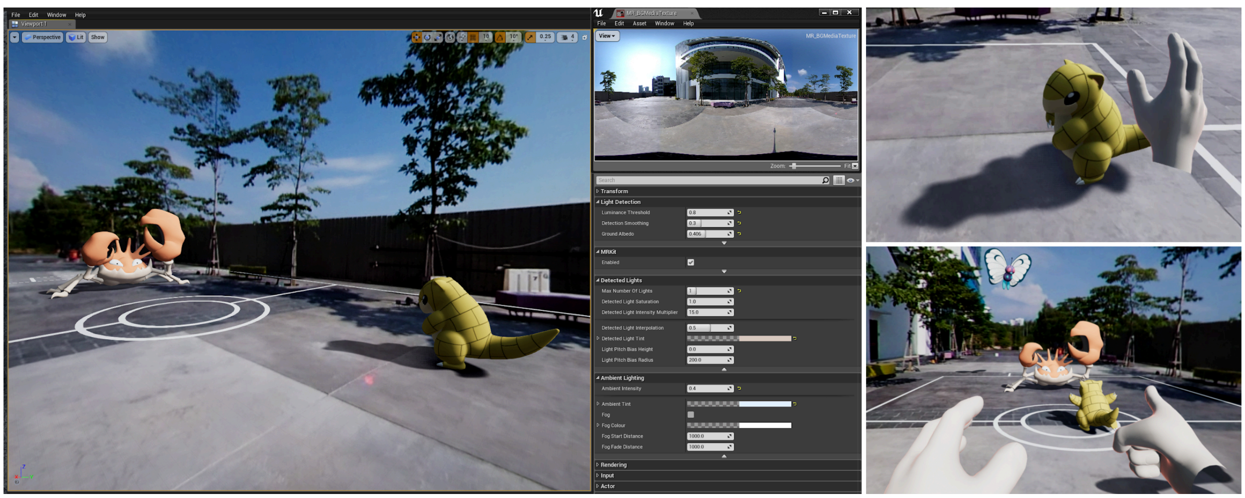

Figure 1: The MR360 toolkit provides an interface to create interactive MR content using 360° video. Our algorithms run in real-time, allowing for novel VR/AR applications where participants can interact with virtual characters which are seamlessly composited into pre-recorded or live streaming 360° videos. ©2018 Computational Media Innovation Centre, Victoria University of Wellington. ©2018 Pokémon. ©1995-2018 Nintendo/Creatures Inc./GAME FREAK inc.

ABSTRACT

We present *"MR360 Interactive"*: interactive mixed reality (MR) experiences using pre-recorded and live streaming 360° videos (360-video) shown in head mounted displays. We present the MR360 toolkit, an interface to create interactive MR content using 360-video. The toolkit detects salient lights in the 360-video and casts realistic shadows. Image based lighting is perceptually optimized to provide real-time results. Differential rendering obtains a composition between the virtual objects and the real-world background. We present two applications of our toolkit: a VR experience using pre-recorded 360-video, and the *MR Stage*, an MR experience using live streaming 360-video. In both applications, participants are interacting with digital creatures with high presence in 360-video.

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CCS CONCEPTS

• **Computing methodologies** → *Rendering*; *Mixed / augmented reality*;

KEYWORDS

Mixed Reality, Image Based Lighting, 360° Video, Video Streaming

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1 INTRODUCTION

360° panoramic video (360-video) captures an omni-directional view of the surrounding environment. The combination of 360-videos and head mounted displays (HMD) provides immersive viewing experiences. Although 360-videos allow for natural visuals from the real-world, interactions are limited to head rotation with no interaction with scene objects in the video. Real-time rendering

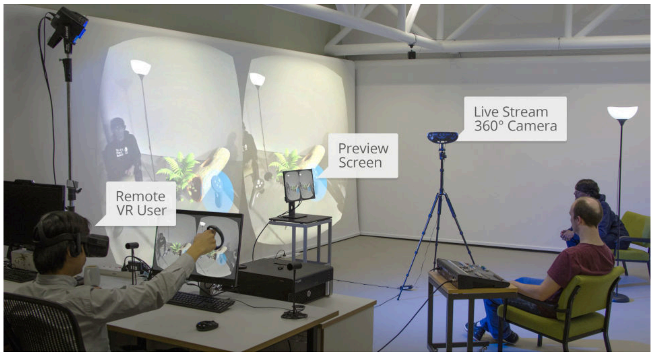

Figure 2: MR Stage overview.

and composition of virtual objects can support such interactivity (e.g., *Pokémon Go*), but they often do not match the lighting quality in real-world scenes.

MR360 provides realistic illumination and composition of 3D virtual objects using low dynamic range (LDR) 360-video as the light source and background [Iorns and Rhee 2016; Rhee et al. 2017]. Our perceptually optimized scheme provides high visual quality and rendering speed suitable for modern HMDs (≥ 90FPS per eye). MR360 does not require any pre-computation, enabling it to support a live streaming 360-video. This allows for novel applications in both virtual and augmented reality (VR and AR). We demonstrate both cases.

2 MR360 TOOLKIT

The MR360 toolkit provides a pipeline to seamlessly blend virtual objects into 360-videos. Since MR360 algorithms are computed in real-time, it allows content creators to add interactivity along with MR360's rendering and composition pipeline. Our toolkit has been integrated into game engines such as Unreal Engine 4 (UE4) and Unity. We support various input devices such as HTC Vive and Oculus Touch controllers, and Leap Motion hand tracking. Figure 1 (left) shows MR360 integrated into UE4, where the content creator can drag and drop a 360-video to set the background and lighting conditions. They can also pull in 3D virtual assets which will seamlessly blend into the 360-video, observable in the editor's preview window. A ground-plane is added to catch shadows. Content creators can add more complex geometry aligned with the 360-video background for improved shadow casting and collision detection.

Through perceptual optimization [Chalmers et al. 2014; Iorns and Rhee 2016], our toolkit supports real-time rendering covering diffuse, glossy, and mirror-like reflections. Content creators can easily tweak the appearance of existing assets since our image-based lighting (IBL) implementation matches existing shading models in UE4 and Unity. We use image based shadowing (IBS) [Rhee et al. 2017] to cast shadows from the IBL. Real-time differential rendering [Debevec 1998] composites the virtual objects into the 360-video (Figure 1). The integration into game engines allows for useful functionality and support from the engine, such as physics, collision detection, game logic, sound, and interactions.

3 INTERACTIVE VR IN 360-VIDEO

MR360 makes it possible for participants to interact with virtual objects seamlessly blended into 360-videos, which can be filmed in various real-world spaces (e.g. urban environments, exotic landscapes, underwater, etc.). In our first demo (Figure 1, right), Pokémon are composited into a real-world space captured as a 360-video. The participant (in a HMD) can interact with Pokémon that seamlessly blend into the real-world. The Pokémon will react and bond with the participant, and can also be sent into battle against another Pokémon. Interactions include face-to-face interaction, pointing at the target Pokémon, or by using instructive voice commands to the Pokémon. Additional participants can view the experience on a display. MR360 seamlessly composites the Pokémon into the 360-video, giving the participants the sense of presence and immersion that the Pokémon and participants both exist in the same real-world space provided by the 360-video.

4 MR STAGE: BLENDING INTO LIVE STREAMING 360-VIDEO

The second demo is an immersive MR experience using live streaming 360-video. The 360 camera is located on the MR Stage (Figure 2, the real-world space where virtual objects are composited into). The remote participant is interacting with the virtual creatures through the live streaming 360 camera on the MR Stage in real-time. MR360 uses the live streaming 360-video to provide the lighting and background to seamlessly blend virtual objects. Participants on the physical MR Stage can view the blended virtual objects and interactions by the remote participant through a display. These participants can influence the MR Stage in real-time by adjusting the real-world appearance (e.g. the light position/colour). The MR stage can provide both the remote and local participants a sense of presence in the same mixed reality space, playing with virtual creatures in the real-world.

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