

[ST] Magical Mystery Room, 2nd Stage

Daiki Sakauchi*, Yuichi Matsumi, Shohei Mori, Fumihisa Shibata, Asako Kimura, and Hideyuki Tamura
Ritsumeikan University



Figure 1: “Magical Mystery Room, 2nd Stage” shows users several DR methods such as image inpainting-based DR and pre-observation based DR. The users can compare those results through a DR-based magic show (left). The users can see those results in real time through a hand held display in stereoscopic 3D (middle and right).

ABSTRACT

We present a system in which users can experience several methods of diminished reality (DR) that removes or diminishes undesirable objects from their perceived environment. Compared to augmented/mixed reality, DR has no appropriate examples of experience-based systems. Therefore, as an example of such DR systems, we developed a system named “Magical Mystery Room, 2nd Stage” that removes objects like a magic show. In this system, the users can see various types of DR methods such as image inpainting-based DR and pre-observation based DR, and experience their advantages and disadvantages. We build a full-scale set in which an user can move around to present various situations depending on lightings and the user’s viewpoint. We expect that experience-based DR system offers opportunities to discuss the future of DR.

Keywords: Diminished reality, experience-based system, mixed / augmented reality

Index Terms: [Computing methodologies]: Computer graphics—Graphics systems and interfaces—Mixed / augmented reality.

1 INTRODUCTION

Diminished reality (DR) that removes or diminishes undesirable objects from perceived environment is known as an opposite concept to augmented/mixed reality (AR/MR). DR has technical difficulties in geometric and optical consistency, i.e., misalignments between a captured scene and a recovered hidden area. From this background, most of existing DR studies attempt to minimize such discontinuities and present their results using hand-held cameras and classical monitors [1, 2]. It is a noteworthy fact that, in research publications, there hasn’t been any good

examples of experience-based DR systems so far that presents the results for user’s viewpoint, for example using a head-mounted display.

Therefore, we have developed an example of experience-based DR systems named, “Magical Mystery Room [3],” in which furnitures are rearranged using DR and MR technologies, and comparing conventional MR-only experience and DR and MR experience. In this paper, we develop our “Magical Mystery Room” system in its “2nd Stage” that provides results of several DR methods through a magic show (Figure 1). In this system, the users can enjoy and see various types of DR methods such as image inpainting-based DR and pre-observation based DR (POB-DR) through a DR-based magic show. Therefore, they personally experience advantages and disadvantages of each DR method in comparison. We expect that such experiences will lead to the opportunities for deep discussion about DR.

In our demonstration, there is a presenter and he will select a participant from the audience. The presenter acts as a magician and the participant sees DR results through a hand held display (HHD, a hand held type head-mounted display).

2 THE PROPOSED SYSTEM

2.1 Pre-Observation Based DR

In this system, a user can see a DR result using image-based rendering (IBR) similar to [2] in stereoscopic 3D.

Camera pose estimation: In POB-DR, it is necessary to estimate user’s camera pose in 6 degrees-of-freedom (6DoF) in real time. We use a hybrid method of vision-based and sensor-based approaches. The system basically uses vision-based method and switches to sensor-based one when the vision-based method is stated as lost. Vision-based tracking tends to fail when the camera moves away from the target scene. Therefore, we use a sensor-based when the tracking gets lost for recovery.

We use a method based on tracking-by-synthesis [4] as an image-based camera tracker. Using tracking-by-synthesis based method, we can use textured 3D model (T-3DM) both for camera tracking and for hidden area recovery.

* e-mail: sakauchi@rm.is.ritsumeai.ac.jp

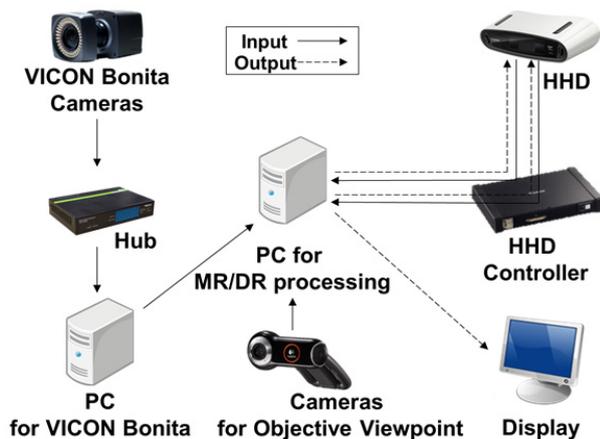


Figure 2: System Configuration

Left and right eyes camera pose estimation is same as in AR/MR system. First, left camera pose is estimated using abovementioned camera tracking scheme. Then, pre-calibrated right camera transformation is applied to it.

Hidden area observation and T-3DM conversion: For the vision-based tracking and hidden area recovery, we need to create T-3DM in advance. We can use commodity methods, e.g., Autodesk 123D Catch [5].

Removal region estimation: In this demonstration, the pose of the target objects in world coordinate system are known, mask image I_m is generated using a 3D bounding box.

Superimpose T-3DM to removal regions: Given the current camera pose, the T-3DM is rendered and superimposed to the captured real scene through the mask image I_m . To make the superimposed region undistinguishable, I_m is blurred and used as an α map for natural results.

2.2 Image Inpainting

The proposed system also provides DR based on image inpainting. Patch-based inpainting (e.g. [6]) is applied and presented to the user. Since it is hard to achieve image inpainting in stereoscopic vision and in real time, the results are shown as a static image.

3 SYSTEM CONFIGURATION

As shown in Figure 2, our experience-based DR system is composed of a PC for MR/DR processing, a video seethrough HHD (Canon HH-A1), and 6DoF optical sensor VICON Bonita to get camera pose. We use HHD because it is handy for users to put on and off to compare DR results and the real scene.

Full-scale set consists of two regions whose geometric complexities are different (Figure 3); one has a simple background and the other has a complex background. To make the scene challenging for DR methods, we put bottles with specular in the complex region. We use well textured walls to make feature point detection easy for vision-based camera tracker.

4 USER EXPERIENCE

Figure 3 illustrates the image of “Magical Mystery Room, 2nd Stage.” The magician hands the participant an HHD and the experience begins. First, image inpainting results are shown to the participant. He/she can compare the results in simple and complex

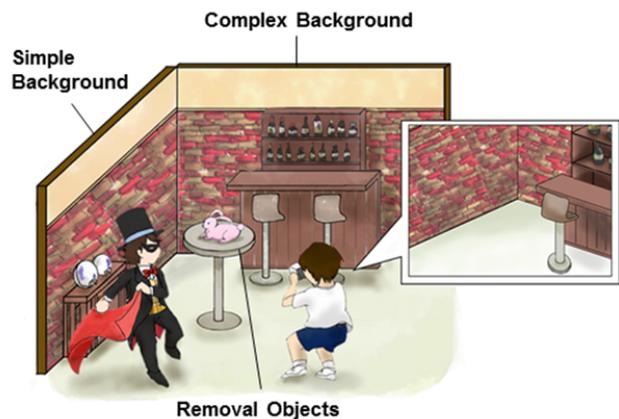


Figure 3: Magical Mystery Room, 2nd Stage

backgrounds. Then, the magician begins his DR-based magic show using POB-DR. In POB-DR, the user can walk around inside the full-scale set and see the results at arbitrary viewpoint.

5 CONCLUSIONS

We developed a system named “Magical Mystery Room, 2nd Stage” that is a DR-based magic show to present technical difficulties of various DR approaches. In this experience, the user can walk around and confirm several DR results in real time.

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Demo Video URL

http://www.rm.is.ritsumei.ac.jp/~sakauchi/ISMAR2015_Sakauchi.wmv