Fountain Designer: Control Virtual Water as You Like

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Abstract

This demonstration provides the mixed reality environment in which users can control virtual water as users like. Users put markers which make virtual velocity field and water moves according to the velocity field. By using these markers, users design their own fountains on the desk. To construct this demonstration, we have been developing a high-speed particle-based fluid dynamics simulation and a rendering method of reflection and refraction with efficient imaging scheme of the surroundings.

Keywords: virtual water, transparent object, computational fluid dynamics, synthetic rendering, multiple cameras

1 Introduction

In previous mixed reality researches, virtual objects were almost solid and opaque, whereas real objects show various phases (gaseous, liquid and solid). We have been developing the synthetic representation method of virtual water in mixed reality environment and in this demonstration "Fountain Designer" we realize "controllable" water which doesn't exist in the real world.

2 User Experience

To make a real fountain all by yourself is a quite difficult task. However, in mixed reality space, you can design it easily and enjoy fascinating and unrepeatable motion of virtual water.

Users can design their own fountain by arranging markers on a real shallow bowl. Each marker has special function to produce a virtual velocity field which affects movement of fluid particles. Figure 1 shows a typical result of a constructed fountain from user's viewpoint.

3 System

The key technologies of this project are (1) real-time fluid dynamics simulation and (2) image-capturing and rendering framework for representation of virtual fluid in mixed reality environment [1].

Figure 2 shows the system configuration of the demonstration. We use two cameras. One captures the scene which users are viewing and the other captures a surrounding scene by using fisheye lens.

We develop real-time particle-based fluid dynamics simulation based on Smoothed Particle Hydrodynamics (SPH)[2]. Particle-based description of fluid is suitable for representing large deformation of fluid which is seen in this demonstration (figure 3). The implementation integrates interaction between virtual fluid and virtual rigid objects, which are represented by particles like virtual fluid.

Refraction and reflection at water surface are rendered using captured images. Because capturing of high-resolution omni-directional image is difficult and most part of the captured image never uses, we propose efficient imaging scheme of the surroundings by using two cameras. An image from user's view camera is used as a refraction texture map and an image from a fisheye camera as a reflection texture map.

Relative position and orientation of cameras and markers are measured by using ARToolKitPlus, which is one of the implementation of ARToolKit.

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Figure 1: Example of constructed fountain

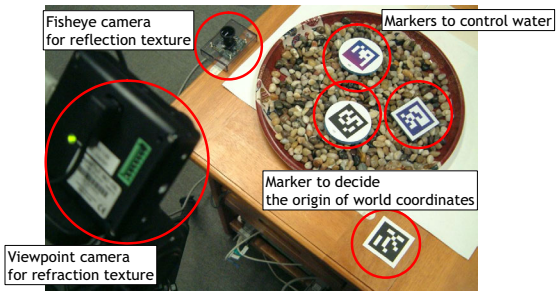
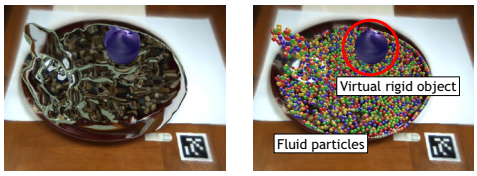


Figure 2: System configuration



(a) rendered image (b) particle description

Figure 3: Particle description of water

References

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