A Virtually Tangible 3D Interaction System using an Autostereoscopic Display

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ABSTRACT

We propose a virtually tangible 3D interaction system that enables direct interaction with three dimensional virtual objects which are presented on an autostereoscopic display.

ACM Classification Keywords

H.5.2 [User Interfaces]: Interaction styles; I.3.7 [Three-Dimensional Graphics and Realism]: Virtual reality.

General Terms

Design.

Author Keywords

3D user interface; tabletop system; interactive game.

1. INTRODUCTION

In conventional touch panel interfaces, operation and presentation are restricted on a two dimensional plane. On the other hand, studies on interaction systems in a 3D space have been conducted. As an example, tangible user interfaces using physical objects have been studied [1]. However, they require application-specific system design and lack versatility. Meanwhile, 3D interaction systems using the VR technology have been developed [2]. However, there are problems that the user has to wear glasses and that practical applications have not been proposed.

With the background above, we propose a virtually tangible 3D interaction system that enables direct interaction with 3D virtual objects which are presented on an autostereoscopic display. In addition, we show implementation examples of two types of interactive games as practical applications.

2. SYSTEM

The virtually tangible 3D interaction system that we propose in this study consists of an upwardly-placed multi-view autostereoscopic display and a camera installed above the display. A user can interact with 3D virtual objects which are presented on the display. The user can view more natural stereoscopic images by drawing 3D scenes from the correct viewpoint. Collision detection between the hands and virtual objects is performed by using images which are captured by the camera. When collision with virtual objects occurs, they move according to the touch position and penetration depth. This gives the user a sense of touching real objects. We use a high-speed camera to reduce latency and to present a feeling of high reality. In addition, we made it possible for the user to interact with a number of virtual objects by implementing simultaneous collision detection with multiple objects and cross-interaction between the virtual objects. Thus, the proposed system realizes direct bare-hand interaction with 3D virtual objects without glasses.

3. APPLICATIONS

Since the system can present higher object reality and gives the fun of operating a lot of objects simultaneously, it is suitable for amusement and education system for children. We implemented two types of interactive games, taking advantage of the features of our system and characteristics of an autostereoscopic display.

![Image](https://example.com/image1)

Figure 1. Interactive games

The first one is the game that the player carries objects to goals with careful attention not to fall off the pathway (Figure. 1, left). There are some holes on the floor, and when objects go out of the way, the objects fall into the holes and return to the starting points. The visual effect of falling objects utilizes stereoscopic view behind the display plane, which gives good stereoscopic effect to the player. The second one is the casino game using a lot of coin-shaped objects (Figure. 1, center and right). The player bets a pile of coins by bringing it to specific areas. After judged by a roulette, the floor of the miss areas open and the coins fall. Since objects with the variety of heights exist at a time, the player recognizes different heights of objects, and feels better stereoscopic effect.

4. REFERENCES
