

bubble cosmos

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1. Introduction

In the field of entertainment, fantaraction is aggressively being developed these days. Fantaraction places emphasis on entertainment and art and imparts momentary surprise or pleasure. This paper proposes a bubble display system (Fig.1) that projects an image onto a real bubble containing smoke and changes the sound effect and image when the bubble bursts. This system enables a user to interactively enjoy written characters or other images projected onto a smoke-containing bubble, and a beautiful tone sounded upon bursting of a bubble, along with a different image projected onto the smoke. To detect a bubble and determine its bursting, a camera input image is divided into areas and each area is checked for a bubble. The bubble position and size are also detected, and an image is projected from a projector.

2. Concept

The bubble display system projects images onto real bubbles containing smoke, detects the natural or intentional burst of bubbles in the air, and outputs a sound effect and projects an image onto the spreading smoke.

By using a smoke-containing bubble as a screen, this system can produce a visual effect never before available. Since an image is not projected onto the surface of a bubble but onto smoke contained in the bubble, the image appears to be inside the bubble. The system also traces a screen bubble with a camera to give the user the impression that the image is floating in the air, following the bubble. Upon detecting the burst of a bubble, this system changes the sound effect and image accordingly. A sound effect is output to produce an unexpected burst sound. In addition, the image is changed after the burst to express a visual effect by the wavering of spreading smoke.

In this study, we realize the above bubble display system by bubble detection with a camera, image projection from a projector, and bubble burst judgment.

3. System

By detecting the position and status of a bubble automatically using video, our system can accurately project a CG image onto a single location and can change the image while providing sound effects upon breaking of the bubble. To detect a bubble drifting in the air, the system processes images photographed by a fixed camera. The images are first converted into grayscale and a moving object is detected from inter-frame differences. Although it is difficult to detect the shape of an ordinary bubble, the smoke

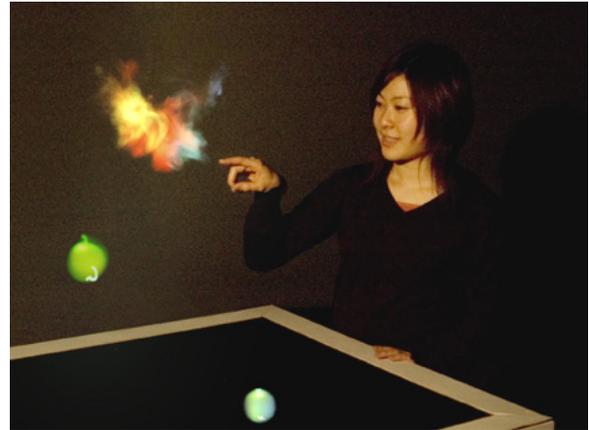


Figure 1. "bubble cosmos" System. Users can enjoy seeing projected bubbles and breaking these bubbles.

inside enables clear detection. Then noise is eliminated by Gaussian Pyramid processing and images binarized with an appropriate threshold are labeled to judge whether a bubble exists in the sequence. For this judgment, several parameters reflecting the bubble characteristics are used. The bubble position and size are detected at the same time. Whether the bubble has broken or not depends on whether the same bubble is in the next frame.

A CG image is projected onto a bubble from a projector just under the fixed camera. Since the optical axes of the camera and projector are very close to each other, projection onto a bubble can be realized by conversion from simple camera coordinates into projector coordinates.

A bubble generator automatically generates a few bubbles about every 15 seconds. Smoke is generated by a smoke machine heating a solution for and is included into the bubbles due to air flow.

4. Conclusion

This paper proposes an interactive bubble display system that could project an image onto a smoke-containing real bubble and allow a user to break the bubble, enjoying a visual change and a sound effect. This system was actually installed and proven to be a fantaraction device capable of giving a user momentary surprise or pleasure. In the future, this system may be available for various applications. The system can be used as a new device for presenting information. For example, this will serve as a beautiful and interactive advertisement. The system can also be used to provide educational contents for small children. The bubble burst judgment function of the system makes the organic and fluidal interface "bubble" available as a switch.