A Real-Time ProCam System for Interaction with Chinese Ink-and-Wash Cartoons

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Abstract

This poster describes our recently developed real-time projector-camera system for interaction with Chinese Ink-and-Wash Cartoons. We implement a real-time interactive water simulation under the acceleration of GPU,together with a sensing subsystem using computer vision techniques. Combined with Chinese stylized fish rendered in process, the system provides real-time interactions with traditional Chinese paintings. By stirring up the still water, fish and other essential elements of Chinese paintings, we hope to present new interaction techniques and more lively Chinese painting sceneries compared to those in traditional static settings.

1. Introduction

Chinese traditional painting dates back to the Neolithic Age about 6,000 years ago. Over the centuries, its unique ink painting techniques have been applied in enormous works of art. With the aid of the merging technology of ProCams, we hope to further push forward the propagation of traditional Chinese culture heritage, creating a new interactive media of appreciating this unique type of art. Such an immersive and interactive approach brings into life the basic elements of Chinese paintings, including ink-and-wash stylized fish, water and lotus etc., providing more vivid and lively interactions that traditional static and nonimmersive types of exhibition can hardly achieve.

Rekimoto and Matsushita[4] realized a computer augmented wall as a virtual aquarium using an infrared camera located behind the wall, allowing users to interact with the wall using fingers, hands and their body. Other similar interaction systems include the Vertigo[3] interactive fish and the "Go Fish"[2] interactive multimedia exhibition.

Instead of using expensive infrared sensor devices, our system uses a Web camera, adopting the background subtraction techniques in traffic surveillance. We run the rendering with the acceleration on GPU, providing real-time realistic reflections and refractions of water effects. The system is still in progress, aiming to provide more interactions using hand gesture recognition and augmented reality techniques.

Figure 1. **System equipment.**

2. System Description

Our projector-camera system is a combination of two parts, consisting of the rendering and the sensing subsystem. The projector is a MITSUBISHI LX390 model. We use a Logitech QuickCam Web camera for capturing and sensing (see Figure 1).

2.1. Rendering phase

The rendering subsystem provides the real-time simulation of water effects and the fish within. We use meshes to represent the water surface, encapsulating a quadruple position, normal, velocity, phase for each vertex. We "stir" up the water by incrementing the velocity of the vertices. We apply the animation texture and blending technique in rendering of the fish and lotus leaves inside the pool.

2.2. Sensing and interaction

We use a Web Camera to sense and detect objects coming into the scene. We adopt the techniques of background

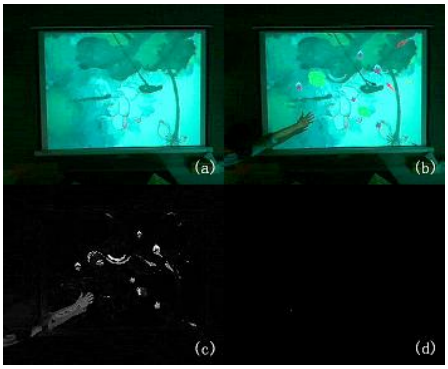

Figure 2. **Sensing using background subtraction.**

subtraction often used in motion tracking and traffic surveillance, marking a pixel[1] as foreground if

$$|\mathbf{I} - \mathbf{B}| > \tau \tag{1}$$

where τ is a predefined threshold.

To do the subtraction, we need to capture a predefined background image, shown in Figure2(a). Then we apply the subtraction to the current captured image 2(b) and get the difference image in grey level 2(c). We apply a closing operation with a 3x3 disk on the binary image, filling the "holes" in the regions.

To tell the moving arms and people from fish and lotus leaves in the background, we search for connected sets in the binary image and apply an area threshold on the detected subsets, filtering the background elements. Finally we compute the centers for each remaining connected set and use them to mark the locations of the foreground objects.

In order to improve the accuracy of the detection, we do the image subtraction in the R,G,B channel respectively. This approach works fine considering the color information contained in the Chinese painting background. For example, in Figure2(a) the histograms for R,G,B channel are shown respectively in Figure3. We modify the weights of the relevant channels in contributing to the grey image according to their histograms:

$$I = \alpha * R + \beta * G + \gamma * B \tag{2}$$

where α + β + γ = 1. α, β and γ refer to the portion of the relevant channel's intensity compared to the sum of the three channels' intensity in total.

3. Experiments

Users can interact with Chinese ink-and-wash stylized fish by stirring up the water and chasing them. They can also trigger the blossoms of the lotus, as shown in Figure4. Children are found especially excited about interacting with the Chinese paintings via our system.

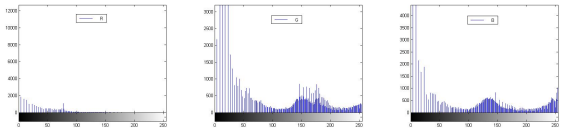

Figure 3. **Histograms for R,G,B channel.**

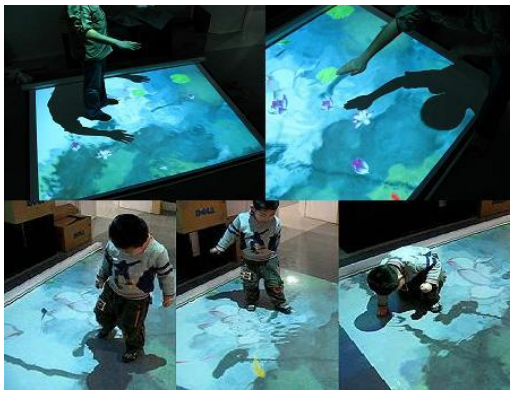

Figure 4. **Demos of interaction.**

4. Conclusion and Future Work

In this poster we present a real time ProCams system for interaction with Chinese ink-and-wash cartoons. ProCams systems are valuable media for culture communications. We can expect more future extensions to the current system by applying other ProCams techniques. We are currently working on other features, including hand gesture recognition for interactions like feeding, guiding and "chasing" the fish. We are also experimenting on multi-projector application for removal of the human shadows. Combined with AR techniques, we can expect to "hold" fish in our hands and explore various other innovative interactions.

Acknowledgements

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References

[1] J. Heikkila and O. Silven. A real-time system for monitoring of cyclists and pedestrians. In *Second IEEE Workshop on Visual Surveillance*, pages 74–81, 1999.

[2] http://www.cityarts.com/lmno/postmasters.html.

[3] http://www.media-fusion.tv/vertigo projection.htm.

[4] J. Rekimoto and N. Matsushita. Perceptual surfaces: Towards a human and object sensitive interactive display. In *Workshop on Perceptual User Interfaces (PUI97)*, pages 30–32, 1997.