A Vision-based Non-contact Interactive Advertisement with a Display Wall

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Abstract. We developed an advertising system that enables users to interact with advertisements on a large display wall without any physical contact. The system recognizes positions of bodies or hands of users in front of the display by stereo cameras. The system recognizes a distance between a user and the display as the user's interests in the advertisement, and changes two display modes according to the distance. One of the modes shows advertisements as many as possible to attract interests of passers-by. The other allows a user to interact with the advertisement on the display by recognizing a gesture of the user.

1 INTRODUCTION

Nowadays, advertisement is very important to inform consumer about information such as the company and their products. Recently, it becomes popular to display electronic advertisements in large displays such as plasma display panels. However, most of those "electronic posters" on the street provides one-way information. Touch panel display is well known to add interactivity to display walls, but the user has to stand right in front of the display to touch it and this causes difficulty to see the whole screen. To solve this problem, we developed an interactive advertising system that recognizes positions of users in front of the display, and tracks user's hands. When a user stands by the display, it allows the user to interact with it by body or hand gestures.

2 DESIGN PRINCIPLES

We focused on displaying and interaction techniques to show information according to users' interests. Our system has two display modes to show advertisements effectively. It uses the attractive display mode when passers-by are distant from the display, and it shifts to the interactive mode when an interested user approaches the display. In order to recognize the distance between them and his body gesture, it is necessary to track users' positions. We employed stereo vision cameras to get depth data of the image to recognize positions of users. In addition, because we target for public interactive displays on the street, we cannot expect the user to wear any markers or special devices. The system tracks the

Fig. 1. System overview

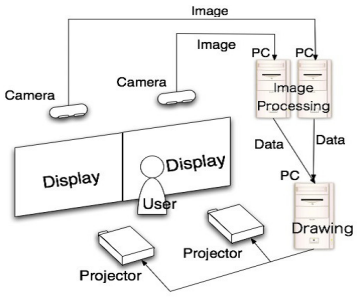

Fig. 2. System structure

positions of hands by the stereo cameras simultaneously to recognize a hand gesture. The system detects a hand by applying a simple background subtraction to color images.

3 SYSTEM IMPLEMENTATION

Our advertisement system consists of three PCs, two stereo cameras, two projectors and two screens (see figure 2). The stereo cameras are Point Grey Research' s Bumblebee, and they are connected to the PCs via IEEE1394 (FireWire). Bumblebee includes a pair of CCD cameras, and its library calculates a depth image from a pair of color images. It provides a pair of color images and a depth image that they are synchronized. The cameras are set on the ceiling and look downward to recognize users in front of the screens. Each camera covers one screen. Two PCs each are used to track positions of users from images of two cameras. The results are sent to the application PC via Ethernet.

4 RECOGNITION FLOW

In this section we describe the recognition flow of the system. The process includes two recognition parts: the body tracking part that detects bodies from depth images, and the hand tracking part that detects hands from color images.

4.1 Body tracking part

In the body tracking part, we use the depth images from the stereo camera for more robust position tracking than color matching or pattern matching. At the beginning of the process, the system obtains a depth image from the stereo camera then scans the pixels whose depth is in the range from 50 to 110 cm from the camera and makes a binary image. Next, the system dilates the binary image to reduce the noise. Finally, it calculates the centroid of each white region.

4.2 Hand recognition part

Contrary to body tracking part, the hand tracking part uses color images as its input. But it causes difficulty in the recognition because of the same reason in body tracking. Therefore, we employed a very simple recognition technique. The system scans only the upper part of the image so that it detects a hand right in front of the screen. Then the system subtracts background image from it and detects a hand region. Finally the system calculates its centroid.

5 APPLICATION

We developed an advertisement system based on this recognition system. As described above, this system has two display modes and switches them according to the distance between the user and the display. One of the modes that shows advertisements as many as possible to attract interests of passers-by, is called *Chaos view*, and the other mode, that allows a user to interact with the advertisement, is called *Tower view*.

5.1 Display mode

Chaos view When nobody is detected at the body recognition part, the system considers that no one is interested in current advertisement strongly, and displays the overall of advertisements. (the up of figure 3)

Tower view When the user approaches the screen, the system considers that the user is interested in the advertisements and shifts to this mode that allows the user to manipulate the screen. Tower view mode has two hexagonal columns. Each column has its own theme (e.g. food, music), and its six surfaces are textured with advertisements. (the down of figure 3)

5.2 Gestures

In the Tower view mode, a user can manipulate the column by gestures.

Selecting a column When the user stands in front of either of two columns, the column is selected, and displayed larger.

Rotating a column In front of a column, the user can rotate it to see the other surfaces by a peeping gesture. (the upper right of figure 4)

Carrying advertisements When the user touches the column by his hand, he can carry the advertisement on the column. The selected advertisements follow him (the lower left of figure 4)

Browsing details If the user is carrying some advertisements, he can put them on the screen by touching the information area that is placed at the end of the screen. (the lower right of figure 4)

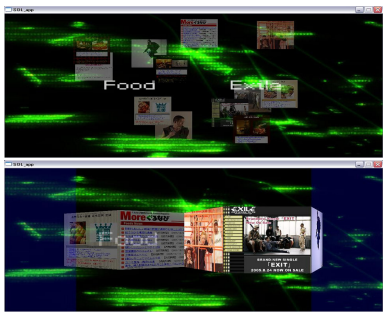

Fig. 3. Screenshots of Chaos view (up) and Tower view(down).

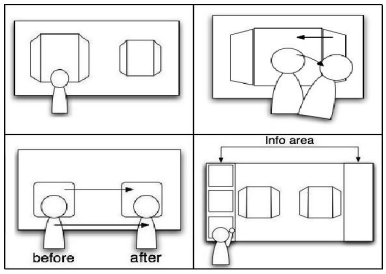

Fig. 4. Gestures in Tower view mode: selecting a column (upper left), rotating a column (upper right), carrying advertisements (lower left), browsing details (lower right).

6 DISCUSSIONS

Carrying gesture is very attractive, but has some problems on the current implementation. Because there is a gap between the two screens and that area is not covered by two cameras, the system fails to track a user when he walks across the gap. To solve this problem, we should change the angles of the cameras or put the third camera. We found that the peeping gesture is not so intuitive. Some subjects could not find and perform this gesture without our instructions. We could put an instruction board beside the screen, but it is not suitable for public use. We should introduce the other gestures for rotating operation.

7 CONCLUSIONS

We developed an interactive advertisement system on a display wall. It tracks users and their hands to allow gestural input. The system has two display modes and switches them when a user approaches the screen. At this time only one user can manipulated a column.

References

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