Development of an Shadowgraph System for Activating Public Spaces

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Abstract
We introduce a shadowgraph system with permanent installation in an effort to activate limited spaces e.g. entrance and lounge of large shopping mall. This system shows or portrays shadows of users and passersby with various effects on a screen. This system will lead spatially-separated people to detecting their images and sound even by far.

1. Introduction
We often stay and have a rendezvous at entrance and lounge areas of large shopping mall or a platform at station. Figure 1 shows example of space. Tables and chairs, drinking stations, statistic merchandise exhibition, ads and so on, are displayed at the place. But these would not be enough to attract people attention, the reason being limited spaces and rooms suitable for customers to stay and kill time.

In this paper we introduce a shadowgraph system for activating impersonal wall. This will lead spatially-separated people on how to maximize their time with space full of people using images and sound.

2. Related Works
2.1 Previous Study of Big Display
There are various studies of big display system being used in public spaces. Flashlight Jigsaw1, The Red Nose Game2 and Hungry Hungry Eat Head are puzzle, manipulate and AR technique games3, respectively. They are considered on how to enhance user’s response and participation, but difficult to use at a lot of foot traffic places because they need to use something special or with hand in hand.

2.2 Previous Study of Public Art
In recent years, there are various digital public arts with interactivity of images and music using computer technology. Ensemble System with i-trace4 produces a natural melody by detecting user’s behavior and traces it colorfully. An exhibition of “Harbor with Air” by Digital Art Project5 has displayed various works e.g. “Constellation of Departure”6 and “Bird of Bag”7. They are fantastic but need large-scale equipment, so they are unsuitable for using activity spaces.

There are also various study cases using shadow: Another shadow8, KAGI9, tool’s life10, Shadow Monster11, Textured Shadow12, Shadow Agent13. To make it more enjoyable, these systems need to approach consecutively, therefore the places where people of various purposes come and go, may not be available and suitable.

3. Shadowgraph System
3.1 System Summary
Using project system with images and sounds, not only for the user but also for people who are staying or walking around.
it can also enjoy watching them (see Figure 2). For the reason of familiarity as to young people, we introduce shadow games.

In addition, we use a refined animation with effects to cover wider range of people.

**3.2 System Architecture**

The system is consisted of input process, contents generating and output process. Input images are simultaneously parallel processed like Figure 3. One is displayed in real-time by getting the difference between user and the background, and then colored the user. Another is to read out organism animations with feeling of vitality, images and sound, they are changed according to the movement of the same.

![Figure 2: Image of the System](image)

**3.3 Generating Shadowgraph Animations**

We will show an image processing flow in figure 4. At first, read in the original color images (a), and then transform it in a gray-scale (b). After that, when (b) exceed a certain concentration value, it recognize the territory as a user’s shadow, and do labeling between user and background (d).

Then, produce the organism animations based on the shadow which we now received (See Figure 5). The labeling shadow shapes are classified by five patterns. Animation is changed depending on a shape, area and position, and effected variously: the 22 type of animation are there.

![Figure 4: Flow of Image Processing.](image)

![Figure 5: Generating of the Creatures with the Layer Structures](image)

**4. Assessment Experiment**

**4.1 Exploratory Experiment**

It is important to detect a behavior in a trice and react in real time. We measured execution velocity using a projector at 1024x768 pixels and camera at 640x480, and get 9 to 10fps. With respect to auditory temporal resolution, rhodopsin isomerization need over 0.2msec in an effort to a light photon is to be a trigger. But distinctiveness ration of visually delay time is not clear now. And so, for seven students to experience the system and make an organism animation, we asked them this question - “Do you feel a sense of togetherness between manipulation and images?” on an ascending risk scale of 0 to 5. The 71.4% answered “Not much” or “No”, so the proposed system suggested the execution speed of the system which makes us feel almost real time.

During the experiment, we could confirm student who are on the way home and visitors were bringing up and appreciating it.
Specifically, people including children were of interest, some children were looked over user’s shoulder. This episode suggests that the system could be attracted by people who see it first.

4.2 Assessment Experiment of Display to Public

The system was displayed in Summer Science Square at National Museum of Nature and Science in July 2010 and we carried out questionnaire investigation for 20 children in elementary school. Table 1 is the evaluation item. It consist of 6 questions and free descriptions. We mainly targeted respondents as the elementary school children, so we were careful of our very language. Figure 6 shows scene of users’ experience.

![Figure 6: Scene of Users Experience](image)

4.3 Review of the Results

Figure 7 shows the result of questionnaire. The average of questions 1 and 5 are 3.91 and 4.09, respectively, and it suggested that a lot of children were playing and had fun. In question 4, 91% answered they want to continue to play, but the deviation of question 2 is 1.51, so it seems that satisfaction depends on the user. We could observe that there are many people who are interested in the system, e.g. dramatic effects. Meanwhile, there are also people who are not completely satisfied with it.

In relation to manipulating the system, the average of questions 3 and 6 are 3.82 and 3.27, respectively. There are some children who argued because they feel it is difficult to consider the turn out as intended, and get the right timing for taking a picture. On the other hand, some children are keen observers of how the reaction is realized based on the result displayed by the system. It is stated that, “Doing the shooting appropriately is difficult”. Additionally, free description suggest that it is better to appear brighter between shooting, as “Making shadow on the screen is difficult”. We will make a modification for making a shadowgraph whenever the user demands, by increasing in the speed of shutter timing.

For future prospects, we will offer a more satisfactory experience by enhancing real-time operability and add more variety of animations. We could animate using an object thrown by the user without utilizing any sort of body movements. The system will be used and played by applying additional poses and gestures of the users, as the case maybe.

<table>
<thead>
<tr>
<th>No</th>
<th>Question (From 0:Bad to 5:Good)</th>
<th>Average</th>
<th>Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Did you enjoy playing with the system?</td>
<td>3.909</td>
<td>1.379</td>
</tr>
<tr>
<td>2</td>
<td>Did you feel short on fun?</td>
<td>4.09</td>
<td>1.505</td>
</tr>
<tr>
<td>3</td>
<td>When you manipulate the system, did it move well?</td>
<td>3.818</td>
<td>1.466</td>
</tr>
<tr>
<td>4</td>
<td>Do you want to play again?</td>
<td>3.909</td>
<td>1.505</td>
</tr>
<tr>
<td>5</td>
<td>What is the atmosphere like?</td>
<td>4.09</td>
<td>1.240</td>
</tr>
<tr>
<td>6</td>
<td>Is it easy to manipulate?</td>
<td>3.278</td>
<td>1.814</td>
</tr>
</tbody>
</table>

Table 1: Evaluation Items and Results

![The average and the deviation](image)

Figure 7: The Average and Deviation
5. Conclusion

In this paper, we present a shadowgraph system for activating public spaces. It ensures availability of using limited spaces and gives people instant pleasure. After discussing the evaluation and observation of children’s participation, we then consider the present situation and future prospects as viable.

References