Gas and Shadow Swing

Chi-Hung Tsai, Mei-Yi Lai, Che-Wei Liu, Shiang-Yin Huang, Che-Yu Lin,
and Jeng-Sheng Yeh⋆

Computer and Communication Engineering Department
Ming Chuan University
{windydodo,cravendo,drummerwei,shirleysky922,comouse}@gmail.com,
jsyeh@mail.mcu.edu.tw

Abstract. In our digital art, we design a folding fan as an interactive magic device. You can use it to play with gas around the world of illusions. Although gas could not be seen in our real world, we still want to interact with it in our illusions by the element of bubble shadows. Opening and swinging the folding fan can blow the bubble shadows away; closing and swinging it can break bubbles. If the magic fan touches the shadow of gas, the bubble shadows will explode and release colorful particles to surround you. Those actions are controlled and located by our circuits with Arduino board.

Keywords: Interactive digital art, folding fan, shadow, Flash, Arduino.

1 Introduction

The wind blows the ground gently. The air flows into the world slowly. The shadow passes through by people quietly. Suddenly, we remember the childhood memories that we played with shadows. So we choose the shadows to be our key idea: we focus on the interaction between people and shadows. Furthermore, we would like to add one more element into our digital work. In summers, what we usually think about is the folding fan. When the fan blows the wind in our work, it can make shadow to swing just like gas can flow. We design a folding fan to be our interactive controller. It lets us feel the magic by influencing shadows. With the help of dancing shadows, we can also feel the existence of gas flow.

2 Creative Ideas

We major in Computer and Communication Engineering. When we step into the field of Technology Art, we find computer and art can combine to become another work. So we are trying to develop it. Gas and shadow are always in our life everywhere. They appear sometimes and disappear at other times. Although we can see the shadow, we can't sight the gas. Even they have thousand or million, people excite to see them.

⋆ Corresponding author.

According to our literature review, we find interactive works which is seldom to use folding fan. Therefore, we try to use folding fan to design an interactive work. We imagine the fan that has magic, then user can use fan to swing and breeze. After that you can see the gas elements. Most of the proportion of gas in aerosphere are making by hydrogen, oxygen, nitrogen, etc. We think the gas is just like shadow, and it follows and fills around us. We can simply aware the shadow, but we can't feel those gas elements existed. Therefore, we let shadow to display the appearance of gas elements. It can explain those gas accompany with us. They are transparent, but actually they touch us all the time. Those gas elements have life; also they have cycle, and they afraid of touching with people. That is the secret of nature. When we enter to this space, folding fan can help you to see those gas elements easily; it can be not only seen but also touched. Be careful, they are very weak.

3   Literature Review

"Sharing the meal" created by Kuo [1] is a funny creation about the shadow. The shadow will change their position or shape when you turn the plane. For example, some animals go along with the rim of the table and run very fast when you turn the plane with fast speed. The creation can be better relationship for people who get the meal on the same dining table (Fig. 1(a)).

In SIGGRAPH 2002, "Molecular Bubbles" [2] is an interactive art by Simpson. The screen will be affected by the body motion. For example, bubbles drifting on the screen and you can cut and circumscribe it by your shadow (Fig. 1(b)).

Then, the other creation is "Shadow Monsters" by Worthington [3]. It will make strange noise and shape when you put your hand or body in the area. Some shape adhered on your shadow. It makes you look like a monster. Your shadow will be difference kinds of monsters, when you shake your body. It looks like those monsters are fighting with the other, so you can play it with someone together at this space (Fig. 2(a)).

There is another interactive art created by Adam Frank. The creation's name is "Shadow" [4]. This is a special interactive creation with people. You would see

(a) Sharing the meal.   (b) Molecular Bubbles.

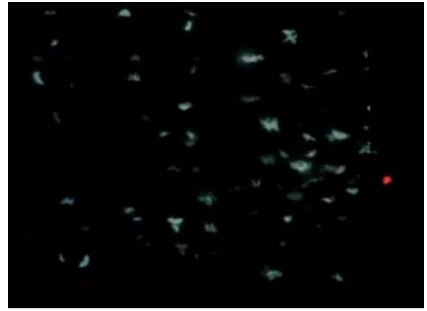**Fig. 1.** Sharing the meal [1] and Molecular Bubbles [2]

(a) Shadow Monsters.

(b) Shadow Project.

Fig. 2. Shadow Monsters [3] and Shadow Project [4]

(a) Prince and Migrant Birds.

(b) Phantasm.

Fig. 3. Prince and MigrantBirds [5] and Phantasm [6]

a shadow beside you and scare of you. It likes the shadow says "Don't approach me!" But, the shadow will be near to you when you intend to go away (Fig. 2(b)).

In SIGGRAPH 2006, "Phantasm" is one of creations by Takahiro Matsuo. The interactive art makes a lot of people to go back childhood. They don't scare the insects and feel that the creation was very amazing. Takahiro Matsuo have another creation is "Prince and Migrant Birds" It's depended on a story about prince. People like holding a magic ball and feel beautiful for the whole area with stars (Fig. 3(a) and Fig. 3(b)).

4   Research Methods

We use Flash [7] to paint the interacting contents and use Flash Action Script to receive the information of the folding fan, including position, shaking frequency, acceleration, and the opening status. Image processing technologies are used to
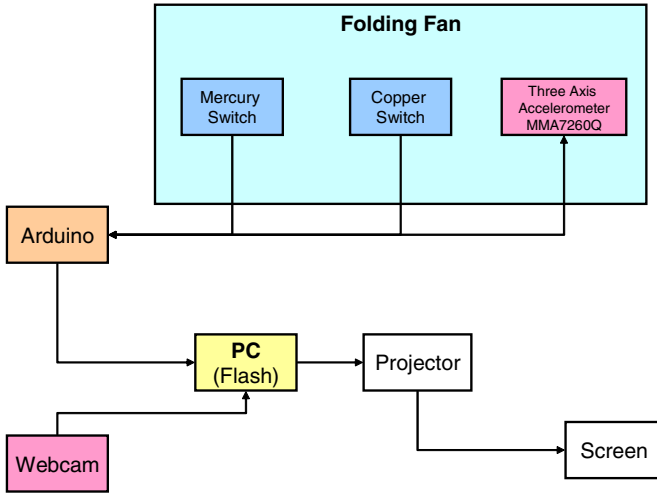
Fig. 4. Hardware setting diagram of our work

decide the region of user's shadow. The shadow regions are important for the interaction by testing whether the user is touching the shadow bubbles or not. The hardware setting diagram is displayed in Fig. 4.

We design a folding fan which is an interactive device in the user interface. It can be also an interactive media between user and screen. When the fan swings,

Fig. 5. Swing the folding fan can stir the object on the screen. If the fan moves faster with higher frequency, the objects will move faster.
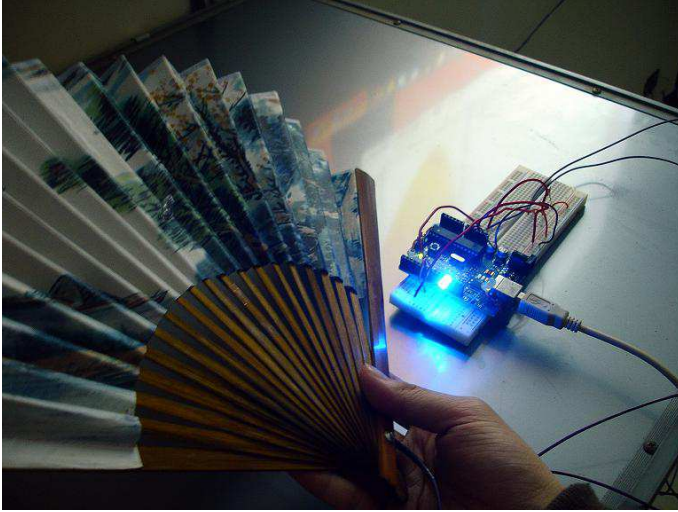
Fig. 6. Our sensor on the folding fan with Arduino

Fig. 7. A closer look of our sensor device on the folding fan

we capture the fan's statuses and play a Flash animation corresponding to the statuses (Fig. 5). Our concept is to simulate an invisible fan virtually in computer to show the amazing effects of fan. Therefore we attach a sensing device to the fan (Fig. 6). The device is built with three sensors: a mercury switch, a three-axis low g acceleration sensor, and a touching copper switch.

Fig. 8. We attach the sensor to the folding fan

Fig. 9. A newer and smaller version of sensor is attached to the folding fan

The mercury switch is used to calculate the swing frequency of fan. When the user swings the fan back and forth one time, the mercury switch will shake once and generate one bit signal. In order to receive the signal from the sensor, we use an Arduino board to receive the signal, to calculate the frequency, and to send the frequency to computer. Those signals will be transferred into PC via USB Port, and our interaction system, written in Flash, can receive those signals using Serial Proxy Server [8]. We can calculate the shaking rate per second then we can obtain the swing frequency from fan. When the user swings the fan and speeds it up, the colorful bubbles the screen will move faster and faster. It will make the simulation of virtual fan more realistically. Other interaction events can also use this information.

A three-axis accelerometer on the fan is used to measure the direction of movement, shaking speed and force, and to help roughly locating the position of fan. When the user open the fan to swing, the objects on screen will swing out slowly from the position of the fan. The speed of movement is based on the fan's shaking frequency. More and more virtual objects will be generated
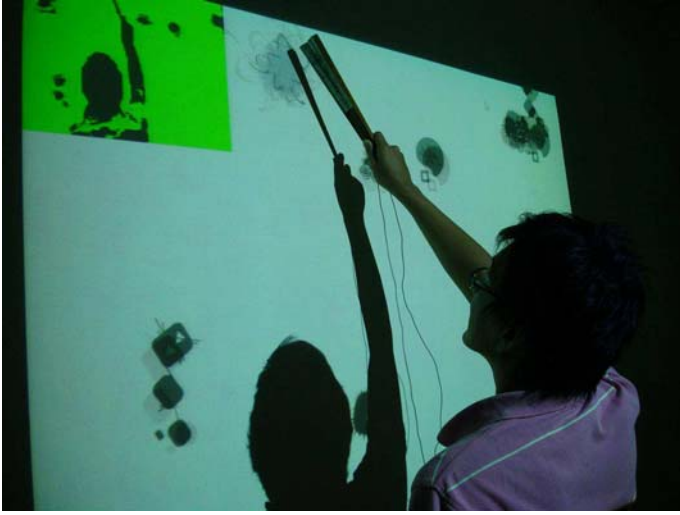
Fig. 10. The user can use the folding fan touch the shadow objects on screen. The shadow object can interact with the player.
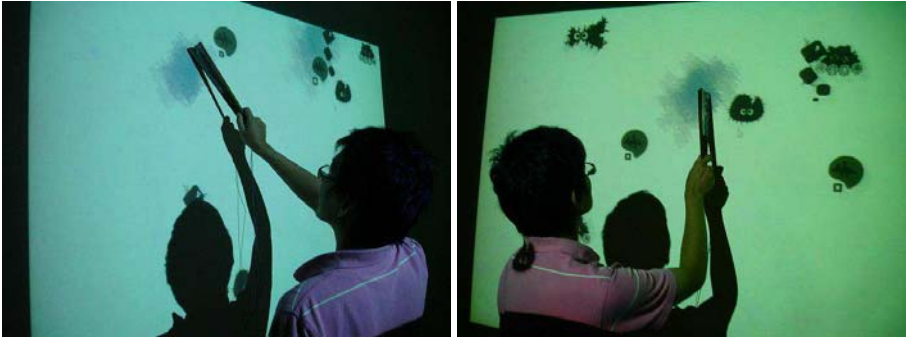

Fig. 11. When the user touch the shadow object, the object will break and release some color smoke spreading the smell of the gas

when swinging the fan and gradually there are full of the objects in the space. When closing the fan, the objects on screen will become touchable with magic exploding. At the moment of exploding, the colorful particles will be released to surround with you.

On the other hand, a webcam is also used in our work. We use the "Bitmap-Data" object in Flash Action Script to create array. We can use this array as a video cube to find where the user's shadow is. We hope the user can not only swing the fan, but also use the fan to touch the gas shadows. When the user

touches the shadow objects on projector screen, the shadow object can interact with the player (Fig. 10). The shadow will be boomed by user, and make difference color on the screen (Fig. 11).

When we were working in progress, we faced two important problems. The first one is to compare two pictures, one is captured by camera and the other is the projecting screen. Because of projection geometry, there are some perspective projection effects. So we used the projection matrix to solve it. A homographic matrix with eight unknowns is solved and used here. Therefore, an initial calibration is necessary. This method can help the image processing to find the regions of human's shadow accurately.

The second problem is caused by the interactive contents on screen. When we draw any magic effect on screen, it will overlap with the shadow of the user and the fan. The overlapping will cause the image processing a little confusing. This problem can be solved by some image morphology operations and a difference operation. We implement and use them in Flash Action Script 3.0.

5   Conclusion

The proposed system provides a new direction of interaction. Image processing for video input from webcam and folding fan user interface are combined together. Some operations of the folding fan including opening, closing, swinging and touching, are designed to interact with the virtual world. When the users use the fan to touch the magic bubbles, bubbles will explode and release some colorful particles spread the virtual smell of the gas. Users can not only swing the amazing fan to generate different flying objects but also play the colorful bubbles or particles by themselves. The thousands of particles will interact and surround you.

References

1. Kuo, Z.K.: Sharing the meal (2006),
   `http://www.youtube.com/watch?v=GHeBod2Atfg`
2. Simpson, Z.B.: Molecular Bubbles. SIGGRAPH (2002),
   `http://www.mine-control.com/bubbles.html`
3. Worthington, P.: Shadow Monsters (2006),
   `http://www.youtube.com/watch?v=g0TOQo_7te4`
4. Frank, A.: Shadow (2009), `http://www.youtube.com/watch?v=oVAywSF_eVM`
5. Matsuo, T.: Prince and Migrant Birds (2006),
   `http://www.youtube.com/watch?v=Ul4X5bEzsDU`
6. Matsuo, T.: Phantasm. SIGGRAPH (2006), `http://www.monoscape.jp`
7. Flash official reference document, `http://help.adobe.com/`
8. Busti, S.: Serial Proxy Server (1999),
   `http://www.lspace.nildram.co.uk/freeware.html`