"Make Your Own Planet": Workshop for Digital Expression and Physical Creation

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Abstract. We propose the "Make Your Own Planet" workshop, which combines handicraft and digital representation tools (3DCG effects). In this workshop, a child uses a USB camera to select textures freely in the process of making an original 3DCG planet. All 3DCG planets are then placed in a simulated universe for public viewing. By watching this universe, viewers can appreciate the planet of each child. Further, the texture of each 3DCG planet is translated to a polyhedron template and printed out as a paper-craft template. In this process, children employ computers to transform their planets into physical objects that they can bring home. We first describe the workshop concept and then the method by which it was implemented. Finally, we evaluate the workshop.

Keywords: Digital workshop, 3DCG, Unity, I/O device.

1 Introduction

Workshops are currently viewed as opportunities for experimental learning. As such, various workshops are held every weekend at educational facilities, such as museums and universities. In Japan, workshops have attracted attention as places of learning.

CANVAS [1] is unique in that it promotes activities that link technology to the expression of children. A non-profit organization (NPO) holds a "Workshop Collection" every March at Keio University's Hiyoshi Campus. In Japan, CANVAS develops and hosts workshops for children at various educational facilities. This expo, now in its ninth year, has grown into a big event, attracting about 100,000 parents and children over two days. Not all the workshops in the Workshop Collection use digital technology, but the number of those that do is increasing.

Most of the systems used in these workshops, require operations, such those provided by keyboards and digital mice. For the reasons described above, older elementary school children are targeted in these workshops.

2 The Concept of Digital Workshop

2.1 The Trend of the Digital Workshop

Typical examples of workshops that use technology are those for creating handmade crafts through computer-aided activities. Many universities research and develop

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systems that support handmade work, such as paper crafts [2], stencil designs [3], and pop-up cards [4]. They then hold workshops to disseminate the results of their research in society. An important purpose of these workshops is to have participants and children experience the "joy of creation" by making their own works.

In these creative workshops, computers support creative activities by providing specialized knowledge, augmenting skills, and reducing and simplifying tasks. In other words, computers serve as specialists or professionals. Here, the relationship between children and computers is vertically structured. However, we attempt to provide structures and devices that enable the active involvement of children in creative activities by using computers; thus, they can experience the "joy of creation."

In this paper, we report the on "Make Your Own Planet" workshop, which combines handicraft and digital representation tools (3DCG effects). In this workshop, a child uses a USB camera to select textures freely in the process of making an original 3DCG planet. All 3DCG planets are then placed in a simulated universe for public viewing. By watching this universe, viewers can appreciate the planet of each child. Further, the texture of each 3DCG planet is translated to a polyhedron template and printed out as a paper-craft template. In this process, children employ computers to transform their planets into physical objects that they can bring home.

2.2 Rerated Work

Workshops that use computers as tools for handmade activities are quite common. Broadly speaking they, can be divided into "programming learning systems," "support systems," "expression tool systems." The planet maker proposed in this paper is an expression tool system.

A programing learning system is the most general example of a workshop that employs computers [5]. Workshop programs that design robots and determine their movements are being implemented all over the world. The purpose of these workshops is to understand the features of sensor devices and programming languages. An understanding of algorithms and complex operations are necessary; thus, they are not appropriate for younger children.

A computer that provides knowledge and offers support system can reduce the difficulty of shaping activities. Therefore, it is possible to produce complex handwork, even with children and beginners. In recent years, support systems for paper crafts [6], pop-up-cards [7], have been developed.

An expression tool system provides to user with expressive activities on a computer. These systems can be seen especially in media art. With "Minimal Drawing" [8], one can draw pictures on a simulated canvas, which is rotated. "Body paint" [9] allows users to draw on walls and experience their own bodies as brushes.

"I /O Brush" [10] is a system relevant to our system. It presents a heightened effect to children by ink drawing that takes pictures as real world objects, thus encouraging youthful creativity. The difference between it and our system is that the latter permits children to create a piece of a three-dimensional entity. Children are able to watch the work of other children at the public viewing. In our system, we liken

a three-dimensional planet to drawing. A child's planet is on public view as a 3DCG animation that simulates the universe. Moreover, the system can print on the spot.

3 System Development

The planet maker consists of three modules: the "Paint Module," the "Space Display Module" and the "Mapping module." In this section, we describe each method to develop a module and each module's functions. Figure 1 shows an overview of the system.

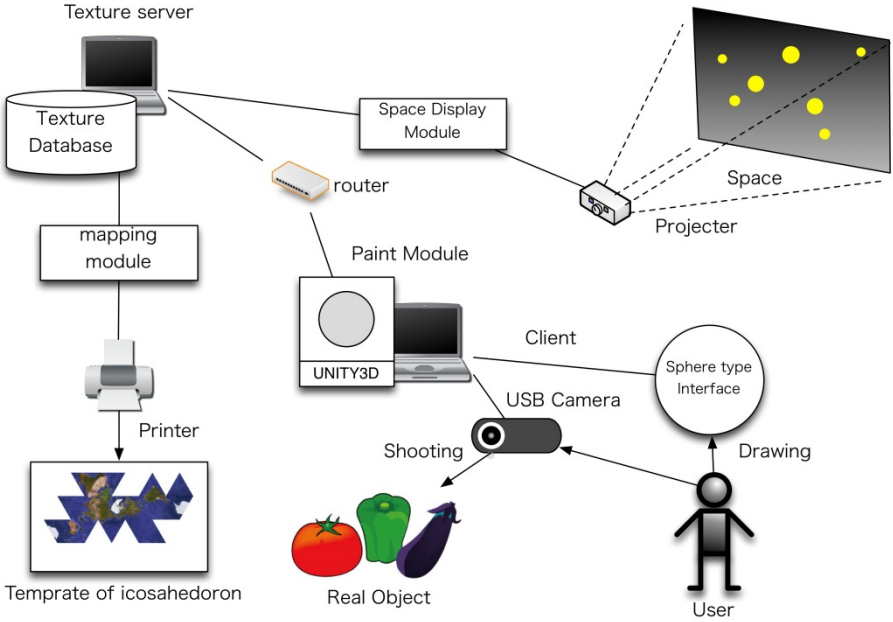


Fig. 1. Overview of the system

3.1 Paint Module

Children can paint the own planets with the Paint Module. This module can paint a 3DCG spherical object using an image captured with a USB camera as ink. Figure 2 shows the principle drawing method.

Spherical Interface
We developed an original tangible interface so that children could paint texture easily on a sphere. This interface consisted of Arduino and Potentiometer. There are a number of buttons on the sphere interface. One performs screen transitions, another is a shutter release button on the USB camera, and a third adjusts volume to alter texture.

These mechanisms are controlled by Arduino, an I / O device. Figure 2 shows the Paint Module GUI and the Spherical interface.

At first, a user takes a picture of an object to use as ink. Next, it is painted with the texture 3DCG display, by specifying the location of any of the spherical interfaces. Paint locations on the sphere are specified by touching the guide above along the longitude. A sphere type interface allows rotation with central axis; thus the user can draw as with a brush.

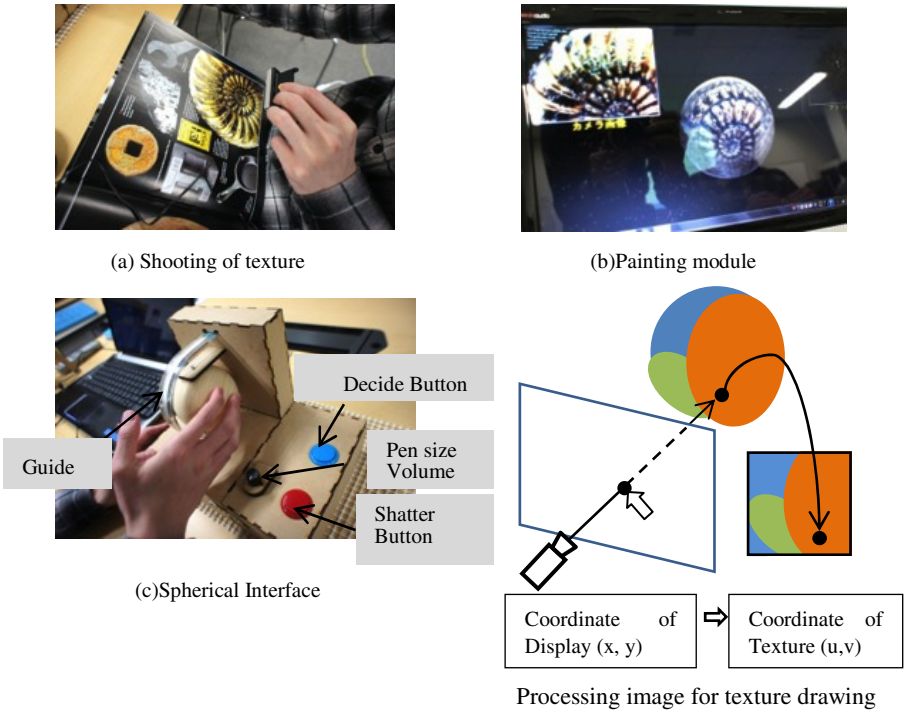


Fig. 2. Paint Module and Spherical Type Interface

3.2 Space Display Module

Space display module is a public viewing module that display all planets designed by the children. The texture of the planet made by the paint module is registered to a texture database. The space display module displays each planet with the texture data newly added to the database. By watching this space, children can appreciate the planet of each child.

3.3 Mapping Module

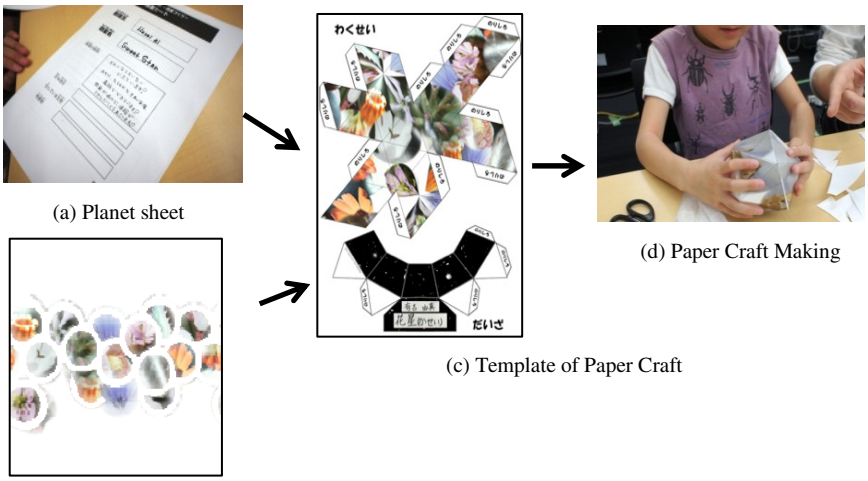
The texture of each 3DCG planet is translated into a polyhedron template with a mapping module and printed out as a paper-craft template. In this process, children are able

to transform the planets that they made with computers into physical objects that they can bring home. In other words, children can make digital as well as physical works.

3.4 Planet Sheet

In a workshop, the name of the producer is described on a sheet, and a portion of a named planet is acquired as a picture with a USB camera.

This picture appears as a label on the preview screen of the planet in a space display module. Figure 3 shows the Paint Module GUI and Sphere Interface. Figure 3 shows the flow of making paper craft template.



(a) Planet sheet

(b) Texture of Planet

(c) Template of Paper Craft

(d) Paper Craft Making

Fig. 3. Flow of Making a Paper Craft Template

4 Make Your Own Planet Workshop

In order to evaluate our design, we conducted a workshop at the Workshop Correction 9 in Hiyoshi Yokohama. The target age range was six years or older, and the time allowed to experience the workshop was about 60 minutes for each participant.

The workshop was conducted by preparing four client terminals. A total of five instructors were assigned as facilitators to move the workshop forward. After the workshop, a survey was carried out in order to obtain evaluations of the workshop.

5 Discussion

We conducted a survey with five kinds of questionnaires evaluation of the interface, degree of work sharing, satisfaction with one's work, and motivation for future work. Another questionnaire contains questions about the attractive elements of "Make your own Planet."

We obtained the results of the survey of 261 children at the workshop. Table 1 shows the questionnaire and items. Figure 4 shows the result of the questionnaires 1-4.

Table 1. Qestionnaire and Items

Q1	Making the planet a camera and sphere-shaped controller What was easy?
Q2	Did you make any refer to the planet of friends when you make a planet?
Q3	Did you are satisfied with the planet which I made myself?
Q4	If you have a chance, do you want to make a planet in this workshop?

	Answer 1	Answer 2	Answer 3	Answer 4	Answer 5
Q1	Very easy,	Easy	Becoming easy	Difficult	
Q2	referred	Often referred	Not to refer at all		
Q3	Very satify	Satify	Soso	Dissatisfaction	Very dissatisfaction
Q4	Very much	If there is time	A little	Not at all	

Q5	Please choice the order that you thought it was fun in this Wakushop.
	A.Drawing the pattern of the planet sphere-shaped controller.
	B.You can choice of design your own image.
	C.The planet of your come out to the universe of public viewing.
	D.That it is possible to see the planet of many friends
	E.You are able to make papercraft of their own planet.

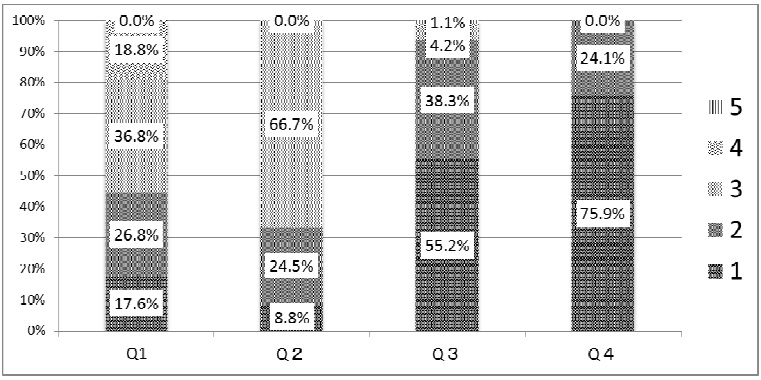


Fig. 4. Result of Q1-Q4 questionnaires

Concerning the usability of the system, 44.4% stated that it was "very easy" or "easy" to use. If "becoming easy with use" is included, the positive opinion was 88.2%. For "work share," "most children stated that they did not "refer at all" to the creations of others. Nearly 70% of the children created an original planet, without referencing those of other participants. An overwhelming 93.2% answered that they "very satisfied" and "satisfied" with their planets. As far as motivation for future work, 75.9% of the children wished to repeat the experience. Since there were no negative opinions, it is clear that the satisfaction with the workshop and the motivation were high. This workshop thus appealed to the children.

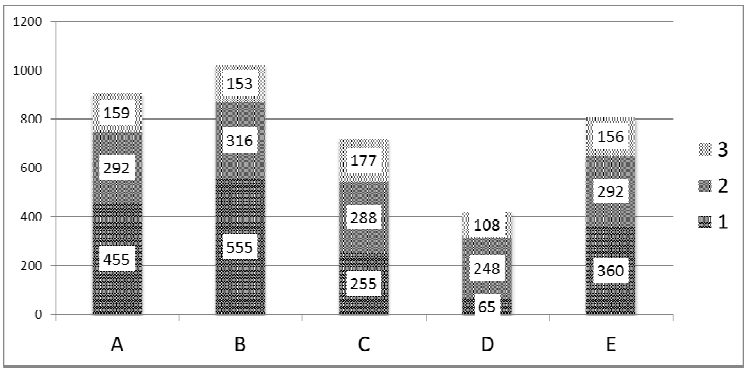


Fig. 5. Answers of Q5 questionnaire

Figure 5 shows the results of the other questionnaire, in which the children ranked activities. The found the ability to choose a pattern freely the most interesting aspect. They had a great interest in employing the planet's spherical controller. Creating a paper planet received third place. From these results, it is clear that making physical objects as paper crafts increased the children's motivation for creative activity.

The proportion of children who created by referring to the works of others was about 30%. The question on the appreciation of the work of a friend had a score lower than those of other items. The children had, however, a positive feeling that their works were shown in a public place.

The space module was received positively, but it did not efficiently function as a tool to stimulate the ideas of children when comparing their works. However, although children liked their own creations, they also expressed a strong desire to view the planets of their peers. The operation of the spherical interface required some practice, but we succeeded in providing an environment in which children employed computers. Thus, we designed and put into operation a fully functioning digital workshop that offered a special creative activity.

6 Future work

For the future, the following two points should be kept in mind. The first is the necessity of improving the spherical interface. The children found it hard to paint part of the pole area of the sphere. The pole area is narrower, since a mounting surface joint is part of the interface base and the sphere. This feature made it difficult to draw. Therefore, we will improve spherical interface, as shown in Figure 6. The second point is the need to improve the space display module used in public viewing. We found that children found it difficult the view the works. To correct this fault, we are currently developing a system that allows a planet to be viewed at the WEB.

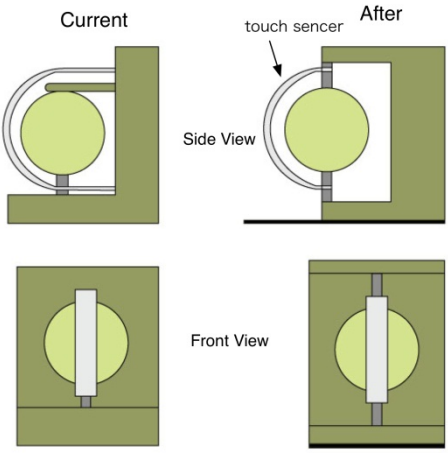


Fig. 6. Image of Improved Spherical Interface

References

1. CANVAS: Workshop Correction, `http://www.wsc.or.jp`
2. Mitani, J., Suzuki, H.: Making Papercraft Toys from Meshes using Strip-based Approximate Unfolding. ACM Transactions on Graphics (Proceeding of SIGGRAPH 2004) 23(3), 259–263 (2004)
3. Igarashi, Y., Igarashi, T.: Holly: A Drawing Editor for Designing Stencils. IEEE Computer Graphics and Applications 30(4), 8–14 (2010)
4. Mori, Y., Igarashi, T.: An Interactive Design System for Plush Toys. ACM Transactions on Graphics and Applications 30(4), 8–14 (2010)
5. Seymour, A.: Papert: Mindstorms: Children, Computers, and Powerful Ideas. Basic Books (1994)
6. Tama Software: Pepacra Desginer, `http://www.tamasoft.co.jp/pepakura/`
7. Li, X.-Y., Shen, C.-H., Huang, S.-S., Ju, T., Hu, S.-M.: Popup: Automatic paper architectures from 3D models. In: SIGGRAPH 10 ACM SIGGRAPH, papers: Article No. 111 (2010)
8. Kusachi, E., Junji, W.: Minimal Drawing: Drawing Experience with both User's Intension and Accidental Strokes. Journal of the Virtual Reality Society of Japan 12(3), 389–392 (2007)
9. Mehment Kten.: Body Paint, `http://www.memo.tv/bodypaint/`
10. Ryokai, K., Marti, S., Ishii, H.: Designing the World as Your Palette. In: Proceedings of Conference on Human Factors in Computing Systems (2005)