PaperStory: A Novel Genre to Inherit Handicrafts Using Virtual Reality

Wei Gai
Shandong University
Jinan, China
gaiwei1987@126.com

Nianmei Zhou
Shandong University
Jinan, China
saaya1995@163.com

Yuqiu Wang
Shandong University
Jinan, China
jywyq96@gmail.com

Ran Liu
Shandong Normal University
Jinan, China
2914515204@qq.com

Hao Liu
Shandong University
Jinan, China
424186771@qq.com

Xiangxu Meng
Shandong University
Jinan, China
mxx@sdu.edu.cn

Chenglei Yang
Shandong University
Jinan, China
chl_yang@sdu.edu.cn

ABSTRACT
In this paper, we propose a novel genre to combine the handicraft elements and the children's imaginations with virtual reality (VR) technology, to improve children's creativity, enhance their interests in this area and promote the heritage of traditional handicrafts. This new genre supports users to select 3D objects, provide the guidelines to direct users to handmade physical handicrafts, enables users to convert their handicrafts to virtual characters, personalize the behavior of the virtual characters, and then construct a VR story so that they can play it using VR device. To achieve this aim we illustrate our conceptual design--the PaperStory.

Author Keywords
Handicraft heritage; creativity; head-mounted display; virtual reality; natural interaction.

ACM Classification Keywords
Multimedia Information Systems - Artificial, augmented, and virtual realities

BACKGROUND AND MOTIVATION
Handicrafts are an important traditional cultural form (such as paper art) and have positive effect on children's development--making handicrafts can not only exercise hand muscles thoroughly but also train the capability of observation and thinking. Meanwhile, the exercise of hand muscles is proved to be beneficial for the development of the right brain, therefore, it can enhance hand-eye coordination and can further inspire children's imagination and creativity, which can encourage them to release their potentiality and personality, making them become smarter while playing.

At present, children and other users usually make handicraft under the guidance of professionals. After production, the models are individually placed for preservation and display. In some teaching, the handicraft is animated to watch. And some products are presented with origami elements and instructions for children to fold themselves.

In this paper, we propose a new genre, in which children can choose 3D models according to the story they want to make, as well as the basic elements of 3D model and animation. The handmade process guidance to guide users is provided. When the papercraft is finished, the physical one can be recognized by the phone camera, and the story content can be personalized, and the corresponding virtual scene can be rendered on the phone. Finally, the user can watch his/her own story and have an immersive experience through head-mounted display. As a first exploration in this direction, we take paper art as our inspiration. We illustrate our conceptual design--the PaperStory.

RELATED WORK
Many researches demonstrate that paper folding is effective for the promotion of some aspects of children's learning ability [3,4] and high-level thinking capacity [1]. [1] reported an experience to teach high school students 3D geometry with paper-folding, and found that hand-on task made students concentrate on class activities, and raised the level of students' cognitive objectives from memorizing to creating. The result of [3] implied that paper-folding lessons combined with mathematics instruction were as beneficial as traditional instruction is in building an understanding of geometric terms and concepts.

Paper-folding is also one of the traditional cultural forms, [6] investigate the effects of ShadowStory in promoting traditional arts and culture among children, which is inspired by traditional art form of Chinese shadow puppetry and captures key elements from it. The user study showed that it promoted creativity and collaboration among children, and at the same time letting children become intimate with their cultural heritage.

In addition to the cheapness and easiness-to-use, the paper also has high plasticity, making it an excellent material for art creation.

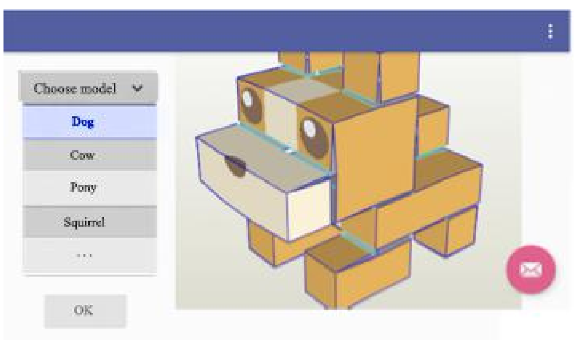
Player-centered design has the possibilities to foster active participation and provide a richer, more interactive and engaging experience. [2] proposed a participatory design approach using VR and low-cost marking tools (such as chalks and ribbons) as a media. And VR technology [5] can provide an intuitive, integral and interactive representation.

PAPERSTORY

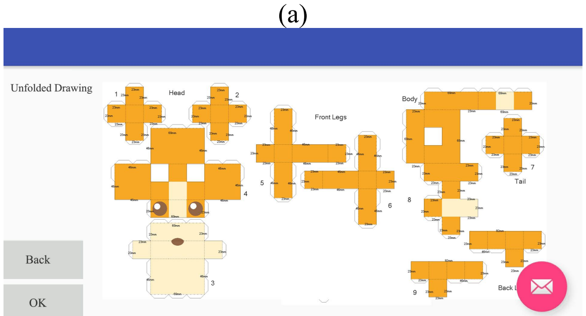
PaperStory has three interaction modes: a “paper folding” mode, in which the corresponding tutorials are offered and a papercraft can be made by children; a “storytelling” mode, in which the behavior information of the papercrafts is configurated after the physical papercrafts becoming the roles in the story designed by users and being personalized with the location, time of appearance and possible lines in the virtual world; and a “experience” mode, in which users can play anywhere.

Paper Folding Mode

In this mode, we provide a database of papercraft models. The user can select papercraft models (see Figure 1a), and then get the corresponding unfolded drawings (see Figure 1b). Meanwhile, an overall and detailed tutorial video will be presented to users in order to give some help when they have troubles in paper folding (see Figure 1c and Figure 1d).

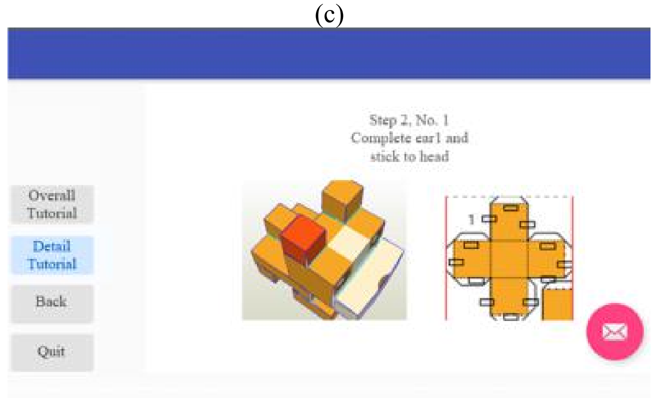


(a)



(b)

(c)



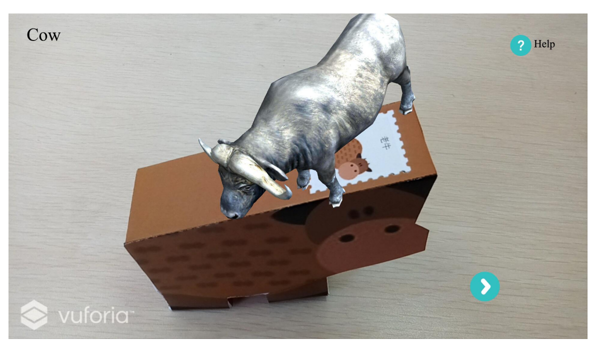
(d)

Figure 1. The paper folding mode. (a): Model selection. (b): The output unfolded drawing of the selected model. (c) and (d): The tutorials of the selected model.

Storytelling Mode

When the paper folding work is finished, users can use the imagination to design their VR stories. We offer intuitive interactive interfaces and simple operations. Digital characters are created on the basis of the physical papercrafts and the behavior of each role is designed on the touch screen of smart phone. The outline of the interactive process is as follows:

Step1: Create digital characters. The pattern of the physical papercraft is captured using a smartphone camera, and recognized by the method of Qualcomm Vuforia [6]. When the physical papercraft is recognized, the corresponding virtual character will be generated with both visual and acoustical feedback. (see Figure 2).



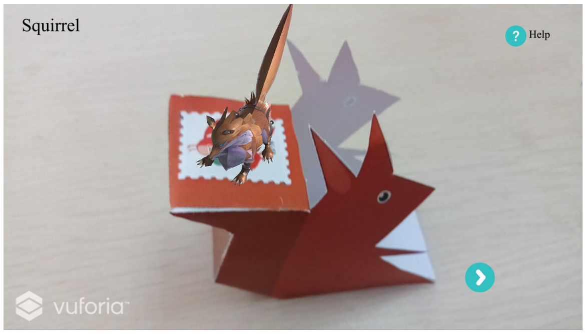
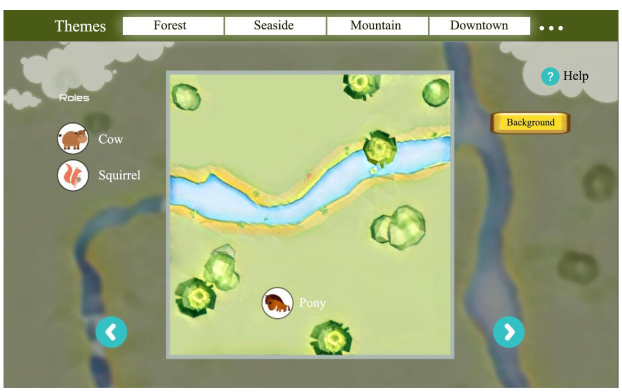


Figure 2. Some virtual characters are created on the basis of physical papercrafts with a smartphone camera.

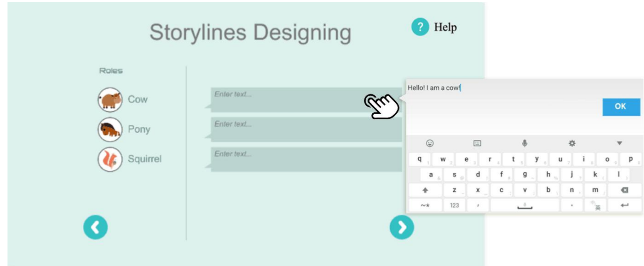
Step2: Make a story. The user first chooses a theme for the story, and then personalizes characters' behavior. Our system provides users with the capability to design the position and the sequence of each role's appearance. In Figure 3a, the user can design characters' positions by dragging their icons and dropping them on the map. The system will then map these coordinates into physical space of tracking users. As shown in Figure 3b, the user can drag the icon and drop them into appropriate cells to control the order, and then he/she can design the storylines for these characters as shown in Figure 3c.

The behavior information of the virtual characters is stored in a file and the system will then construct a virtual scene on the mobile phone.



(a)

(b)



(c)

Figure 3. The process of making a story.

Step3: Experience the virtual world. After the VR story are created, the user can switch to the experience mode. Firstly, the system loads the content of the story to construct 3D virtual environment, and activates the tracking sensor to complete the initialization. Then, the user wears cardboard 3D glasses (see Figure 4) to view the virtual scene and interact with the virtual world guided by tracking sensor.

In Figure 5, the pupil is experiencing the story of a pony crossing the river. The virtual pony is created by the physical pony made by her (see Figure 5a). The content of the story is designed through the interactive interface (see Figure 3). When she enters the virtual world, the movement of her in the physical world can be mapped into the virtual world and control the movement of the pony.

Figure 4. BaoFeng cardboard 3D glasses.

(a)

(b)

Figure 5. Immersive experience in the virtual world and the virtual scene through cardboard 3D glasses.

The hardware of the system includes a tracking sensor and cardboard 3D glasses, presenting stereoscopic images. The tracking sensor we select is Microsoft Kinect sensor. The Kinect and the gyroscope of the smartphone are jointly used to keep track of users' orientations and positions in order to control viewing parameters in the virtual world, and allow natural interactions with it.

CONCLUSION

In this paper, we proposed a new way to express children's creativity and participate in the process of story design, in which the handicrafts can become characters in the virtual world, and be personalized. It also offers an environment where users can easily and quickly immerse themselves in magical worlds. The main innovation of our system was that it was accessible for users to make handicrafts, enhancing children's interest in this area and promoting creativity and collaboration for children.

ACKNOWLEDGMENTS

We would like to thank all reviewers for their valuable comments. This work is supported by the China National Key Research and Development Project 2016YFB1001403), the National Natural Science Foundation of China under Grant (61472225), the Shandong Provincial Science and Technology Development Program (2016GGX106001, 2015GGX101046), and the China Postdoctoral Science Foundation (2017M620284).

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