

# Support Physically Interactive Multimedia Design with an Authoring Tool

Su-Lu. Lu, and Ying-Chieh. Liu

**Abstract**—Physically interactive multimedia is in the emerging field of human-computer interactive (HCI) design in which the applications allow users to operate by means of body movements. Developing these applications often involves a wide range of skills, such as computer science, art and design. Thereby, this is often thought to be very challenging and laborious for students when undertaking the related courses. This paper proposes a teaching strategy to allow students to reduce the demands of programming skills and technical know-how, and to rapidly get the design results and amend where applicable with ease. As part of the strategy, an XML editing environment (XEE) is developed for university students to design physically interactive multimedia applications. Within the XEE, students set up, run and display their designs, and edit multimedia components intuitively with an XML-based template.

**Keywords**—Authoring tool, multimedia design, physical interaction, XML editing environment

## I. INTRODUCTION

PHYSICALLY interactive multimedia design requires the integration of both still and moving multimedia components, and allows operation of the design by means of human gestures. To complete a project of such a complex design, students are required to have an expertise in a combination of disciplines, including artistic, design and engineering. This requires not only understanding of the related technological principles, but also programming activities. For most of non-programmers, programming is a very difficult task (Pane, Ratanamahatana & Myers, 2001; Milne & Row, 2002). Programming languages are more formal and differ from natural language. Beginning students in the field of physically interactive design could be easily overwhelmed by the programming skills which may become a barrier for learning.

Therefore, difficulties might arise for university students when designing applications that require the integration of different fields of knowledge and technical expertise. To minimize students' learning challenges while meeting course objectives, an overall strategy and its learning process are necessary to lead students to complete their designs. The common one is called project-based learning (Morsund, 2002; Chang & Lee, 2010) which allows students to identify and

formulate their problems, and to perform tasks to solve them. To come up with the solutions, students in a team were required to reach a consensus on the selection of design topics and the use of technological advances (McLoughlin & Luca, 2002). This type of teaching is commonly seen in design education (e.g. industrial or architectural design) for years (Reimer & Douglas, 2003; Hundhausen & Brown, 2008).

As the background of team members is critical to the success of the project, a team composed of students with similar backgrounds would be a disadvantage when dealing with cross-disciplinary tasks, such as the work related to physically interactive multimedia design. To deal with this, one approach, studio-based group-work, was proposed by Thomasen & Czcan (2010) and involved in the collection of students with art or engineering background from four different countries in the European Union. In consideration of a particular university's regulations, the availability of students with appropriate backgrounds, and communication challenge inherent in an interdisciplinary design team, applying the studio-based group-work approach would be challenging.

An alternative approach proposed in this article is to supplement the learning strategy used in design education. This approach tends to ease the load of technological usage and allows students with similar backgrounds, or limited previous experience, to be able to complete their project, as well as to encourage them to further broaden their exploration in related domains. To facilitate physically interactive media design, this study aims to develop an "intuitive" editing environment with the goal to reduce students' programming and technological tasks so as to allow them to pay attention to creative activities, and to ensure that their designs reflect original ideas. This paper presents the environment. Further, examples using this environment are demonstrated.

## II. THE EDITING ENVIRONMENT

### A. Using e-book design as the template

The use of physically interactive interaction has been shown to be a pleasurable experience (Laurel, 1993; Oviatt & Wahlster, 1997), and would lead to designing a more natural, flexible, efficient, and powerfully expressive means of human-computer interaction (Oviatt, 1997; Graham, 1999). A design environment was proposed to assist students to set up, run and display their designs. The environment was designed to be simply and easy to allow students to edit multimedia components (e.g., images, audio, and video clips, and text files).

Steps of software development were encapsulated into

Su-Lu. Lu is with Department of Digital Technology Design, National Taipei University of Education, Taipei, 10671 Taiwan (phone: 886-2-66396688 ext 62478; fax: 886-2-27355912; e-mail:lu@tea.ntue.edu.tw).

Ying-Chieh Liu is with Department of Industrial Design, Chang Gung University, Tao-Yuan, 333, Taiwan (e-mail:ycl30@mail.cgu.edu.tw).

modules. The modules were decomposed into the module used for learners' design input as multimedia elements and the supporting modules. The details of this environment and the learning process are addressed as follows. To start with the development of the environment, a physically interactive e-book design was selected as the theme of the project, chosen from a variety of multimedia design applications. E-book contains text-, image-, audio-, or video-based multimedia components (Gardiner & Ronald, 2002). The reason for selecting e-book design as the theme was that an electronic book has developed to a level that it is now a main trend for both information communication and new publications. Also, physically interactive technology integrates sensor technology into a wide variety of design applications that facilitate user interaction with an e-book that is beyond the scope of a mouse or a keyboard. More templates can be developed based on this idea.

**B. The Conceptual Framework**

The conceptual framework of the environment (shown in Fig. 1) consisted of a front cover, back cover, and text page (including contents page). The switch from one page to the next was depicted by the left or right turn of a page, which was analogous to turning a page in a printed book. One physically interactive component was developed to allow learner's input by means of waving a hand. A webcam was used as the sensor to detect the messages of body movements. Traditional user interface was also included, i.e. keyboard, and mouse. To ensure the waving of a hand was appropriately detected with a webcam, a testing corner was designed to display whether the user and the webcam were appropriately located and whether the hand was detected. When turning a page, the framework will also generate visual effect to emulate the turning of a printed book with accompanied sound.

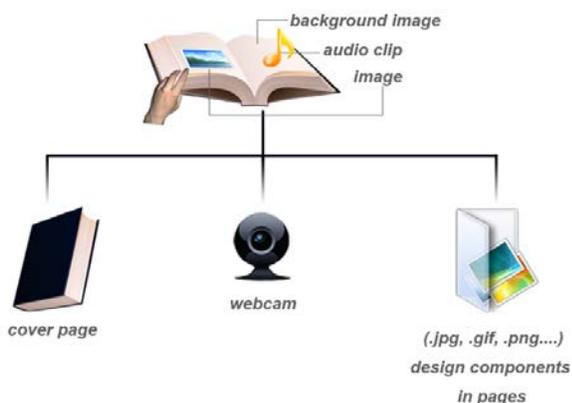


Fig. 1 The conceptual framework of physically interactive e-book used as the design template in this research

**C. Editing the Environment**

To edit any page, learners allocated multimedia elements on the page and inspected the result of the allocation. This allowed the learner to refine each page for improvement. Two motion detection areas were located in the upper-left corner and upper-right corner. The size of each page was A4 (210 × 297 mm). The resulting e-book can be displayed on PC monitor(s) or projector(s).

Within this module, learners could following the concept of traditional book editing that allow users to edit the cover page and content page. Users give input in terms of multimedia (text, audio, video, etc.) under XML editing environment shown in Fig. 2. This activity used text processor software, similar to the editing capability provided by Microsoft Word or Word Pad. Learners could therefore pay attention to concept development with no major technological barrier. There was no extra mental effort for learners to learn the environment. The content of the e-book was developed in this module. To use the environment, learners were required to complete the following steps (shown in Fig. 2): (1). Install Flash (version 8.0) and webcam under the operating system of Microsoft Windows XP; (2). Prepare multimedia elements that will be used in the e-book (shown in Fig. 3); (3). Edit XML-based template; (4). Activate the program for displaying the resulting e-book; and (5). Review the results of the design.

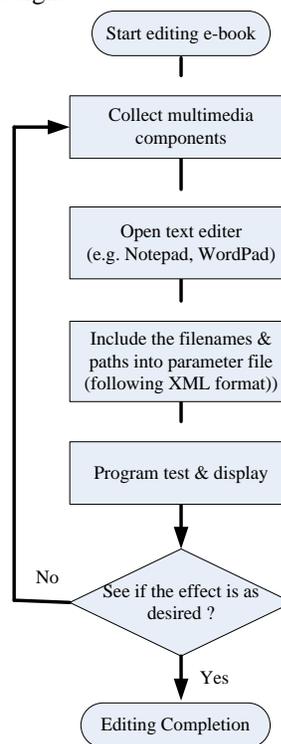


Fig. 2 The editing steps of design activities in the environment

**D. Developing the Template**

To develop such an environment, both the technical architecture of hardware and software were considered. Software was developed to allowed learners to implement designing of e-books with less programming effort. This environment was implemented under Microsoft Windows XP

operating system and C#, and Action Scrip 3.0 programming language was used to develop software modules. A flash player was installed to display the presentation of the e-book design. Hardware was a PC desktop or laptop with a webcam. To meet the learner needs, three modules were proposed: an image processing module, a processing module and a multimedia design module. Image processing and processing modules were implemented to deal with detection of image and establishment of the template, allowing learners to pay attention to the context and contents of the design. Each module is described below.

**Motion detection module:** Unlike traditional e-books with no use of image process technology, the environment was equipped with motion detection technology to identify movement messages (i.e., video stream received from a webcam) allowing pages to be turned through physical interaction (the waving a hand). Detecting the movement of waving a hand required information exchange between a computer and a webcam. This was implemented on the platform of Microsoft Visual Studio 2005 using C# programming language. An execution file was developed in this environment which allowed learners to simply click to activate the function of detecting the message after the installation of a webcam. The image detection algorithm was based on temporal differencing method (Chang, Chia & Yang, 2005; Radke, Andra, Al-Kofahi & Roysam, 2005); a difference was determined through the comparison of two consecutive frames. Once the difference was identified, a predefined message could be sent to processing module.

**Data processing module:** The module was developed to process data derived from the image process module and to send the data back to the image process module. Also, the processing module is comprised of other functions which allow the activation of the e-book for display, the inclusion of parameters of the e-book given by learners, and the uploading of multimedia elements (e.g., cover page picture, music, text, etc.). Any specific effects (e.g., in visual and audio) that require programming techniques were implemented in this module, such as displaying the visual effect of turning a page. This module was developed with the use of Flash CS3 using Action Script 3 script. The main contents of the e-book implemented in this module were:

(1). Hidden buttons were implemented to function as the switch for turning a page. The buttons were developed on the upper-left and upper-right corners. The button on the upper-left was functioned to turn the page from the left to right, while the button on the upper-right was to turn the page from the right to left. The message activating the button was sent from the image process module, or from mouse or keyboard.

(2). Page insertion was developed to allow the input of total page number to generate the perceived pages for learners to edit.

(3). The effect of visual turning with accompanying sound was constructed to produce shadow and falling effects so as to mimic the physical effect of turning an actual book.

**Multimedia design module:** This module was developed to allow learners to edit and display their designs. Learners in this module embody the content of the template after parameters and multimedia elements were input. This is to allowed students to edit multimedia components in a XML-based template to demonstrate their designs. Display of the design was made

through the execution of the file in the XEE that merely requires the inputs of few commands. Student designs were refined through an iterative manner by simply modifying the contents of the file until he or she is satisfied with the result.

### III. THE EXAMPLES

As for whether the environment would support the diversity of the design projects, two aspects can be considered, i.e. the diversity of the themes that students completed and the diversity of physically interactive pattern. First, the template of the environment could be expanded from the theme of physically interactive e-book to the other themes including games, catalogues, and artistic representations. Second, at least four patterns of designs for physical waving were summarized. Physically interactive movements were perceived as (1) page turning in an e-book, (2) switching statuses in a game (e.g. switch to change costumes on a story character), (3) the cause-effect relation of waving a hand, and (4) a conceptual linkage between two statuses. An example of the first pattern is shown in Fig. 3, which was the revised story of Snow White. The design re-characterized the story and designed figures to show their creativity. The team utilized the switch to turn a page to carry on or reverse the story. The second pattern is shown in Fig. 4, in which the design of e-paper dolls was demonstrated. The design treated the switch of pages as the change of costumes on the model. A variety of picture files containing clothes were displayed. The third pattern, as shown in Fig. 5, the switch of a page was recognized as the status change of a punished student. With the use of animation and sound, the design attempted an emotionally amusing card to demonstrate that a naughty student was punished. The waving of a hand was the cause-effect relation as illustrated by the slapping of a hand on the student's face. In Fig. 6, the design translated the switch of a page as the channel of communicating with people, and used a red line to represent the channel. The switch of a page was treated as the change of communication channel which had until then been continuous but now, however, was disrupted.



Fig. 3 Snow White Leaving Home/Authors: Kuo, Gie-pon & Wang, Bei-chi



Fig. 4 Paper Dolls / Authors: Yan, Jing-you & Li, Ying



Fig. 5 School Bells to Ring /Authors: Bian, Cam-chao & Zeng, Pa-chi



Fig. 6 Communication and Barriers /Authors: Zhang, Shin-Ging & Yeh, Chun-ying

#### IV. CONCLUSION

This paper proposes a tentative strategy for supporting students in physically interactive multimedia design, aiming to minimize technical and programming details and advances so as to allow them to spend most of the project time in designing contents of e-books with less concern for integrating technological disciplines. The strategy was implemented in the XEE for physically interaction multimedia design. The results showed that the environment were easy and useful, and enabled the students to complete their projects that involved in physically interactive multimedia design.

Although the strategy proposed in this paper seemed to be encouraging, much research is required to further investigate didactic format and appropriate contents for physically interactive design education; the value of this research relates to its role in proposing a tentative strategy that students found easy to learn, that made them capable of completing the design while at the same time enhancing their willingness to do further learning in related fields. Also, the environment addressed in the research could serve as a teaching aid for interactive design educators or practitioners.

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