DESIDOC Journal of Library and Information Technology, Vol. 28, No. 4, July 2008, pp. 35-42

Online Exhibition Authoring System with Intelligent Affective Background Image Composition

Pai-Hsun Chen[1], Jen-Shin Hong[2,*] and Sheng-Wen Shih[2]

[1]*Department of Computer Science and Information Engineering*
National Nai Kai Institute of Technology, Taiwan

[2]*Department of Computer Science and Information Engineering*
National Chi Nan University, Taiwan
[*]*E-mail:jshong@ncnu.edu.tw*

ABSTRACT

This study addresses the development of an online authoring system that can be integrated into a typical digital archive system to facilitate the construction of online exhibitions. One common approach for the efficient online authoring is based on a principle that decomposes a hypermedia presentation into a "content document" and a "style template." This study proposes a layer-based architecture to further decompose a style template into a number of presentation layers. The approach eases the burden for implementing large-scale style templates in digital museum projects demanding versatile presentation styles. Particular attention has been focused on the mechanism for affective background image composition that incorporates the concerns of the affective colour scheme and the page layout. A system implementation has been successfully applied in real world digital museum projects for constructing aesthetic online exhibitions.

Keywords: Virtual exhibition, online authoring, affective presentation, colour schemes.

1. INTRODUCTION

Online exhibitions provide a low-barrier mechanism for users to easily access and appreciate the precious artifacts archived in a digital museum. Conventionally, online exhibitions are developed by joint efforts of content experts, graphic designers and computer technicians. Such a typical development process is laborious and time-consuming. For a large-scale digital museum project, an effective hypermedia authoring system to facilitate the development of online exhibitions is crucial. One common approach for the online authoring system is based on a principle that decomposes a hypermedia presentation into a "content document" and a "style template." A typical workflow includes three steps, namely (i) determine a practical common logical structure of the exhibition pages, (ii) use a content authoring interface to fill in the contents of the exhibition pages and the inter-page structures, and (iii) select a pre-fabricated style template for each page for the final presentations. With such an approach, the workflow for developing the online exhibition improves significantly since the styling process is separated from the content authoring process.

In the current Web environment, a common way to realise the principle of separating the content authoring and styling processes is to use the "XSL-based" approach[1,2]. The approach uses an Extra Markup Language (XML) document for describing the content and its structure. In the presentation stage, a corresponding Extended Style Sheet (XSL) document is used as the style template to transform

the XML-based content into HTML-based presentations. In such an approach, the presentation style is limited to that can be expressed in HTML and Javascripts supported in a typical browser. In addition, usually an XSL document needs to be prefabricated in its entirety. A minimal variation in a desired presentation style (such as a slight change in the title font setting, the content image size, or the number of paragraphs) requires a different XSL template. In a large-scale exhibition that demands significantly number of different presentation styles, the XSL-based approach requires laborious implementations and management of considerable prefabricated XSL documents and is therefore unpractical. Currently, for developing large-scale exhibitions emphasising on the aesthetic and affective dimensions of the presentation so as to stimulate the contemplations of the artistic works therein, there is still a thirst for a really sophisticated authoring system that significantly facilitates the authoring process while provides high quality presentations.

Overall speaking, the design of an optimal hypermedia authoring workflow needs to consider a balance between like (i) the complexities of the authoring process, (ii) the aesthetic qualities of final hypermedia presentations, and (iii) the efforts for large-scale implementations of the style templates. In this study, we present a system based on a "layer-based" style template architecture. Our goal is to implement a system that allows the content providers to efficiently develop large-scale media-centric and animation-based presentations. A particular focus in this study is on the mechanism for intelligently composing the affective background images that accounting for the page layout and colour combination schemes for the presentation. An implementation will be presented.

2. A LAYER-BASED ARCHITECTURE FOR HYPERMEDIA AUTHORING SYSTEM

A typical hypermedia exhibition contains numerous interlinked hypermedia pages, which contains "content elements" as well as "style elements" (e.g. background animations, decorating graphics, interactive patterns, functional scripts, audio-loops, layout settings, font typesetting, etc.). In our layer-based framework (Fig. 1), a typical hypermedia presentation is decomposed into number of "content layers," including the title, texts, and images. Each content layer is presented by a corresponding "content layer presenter" which is the style module responsible for the stylization and animation of the content in the layer. A content layer presenter is essentially a module in which the content formatting, interactions and decorative graphics, all encapsulated in a self-contained document. The

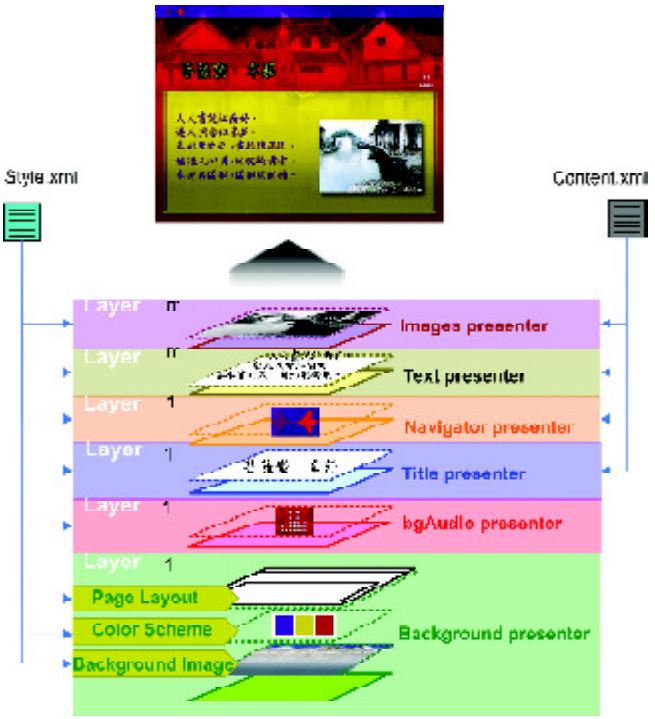

Figure 1. The layer-based architecture for the hypermedia presentation system.

presentation in each content layer can be regarded as a building block, which can be assembled into a hypermedia presentation. Beyond the content layer presenters, a style template includes styling layers presenters, namely, the background image, background audio, and special effects (such as animations of raining, snowing, thunder, fireworks, etc.), that are used to help to create a particular style or affective states desired for the presentation.

In the framework, a style template describes all the layer presenters for a content document. By switching the layer presenters in the style template, the content document can then be presented in different fashions based on the combination of the layer presenters. In addition, the position, size, rotation angle, transparency, and the dynamic movement of each layer presenter can be adjusted to create complex layouts and animation styles. The temporal behaviours of the presentation can also be assigned by adjusting the temporal schedules of each layer presenter in the style template. This modularization framework significantly improves the reusability of the style elements in a project. Our implementation has verified the applicability of such a framework in current Web environments. In the following, we elaborate our design of the intelligent background image composition module based on page layouts and colour combination schemes.

3. THE BACKGROUND IMAGE COMPOSITION MODULE

Style and affection aspects are important design factors of multimedia presentations such as web-pages[3]. Through emotion and style, a presentation grabs the attention of the audience. The colour scheme in the page is one key design factor that professional designers frequently use in their attempts to develop emotion evoking multimedia presentations. A colour scheme is the combination of colours used in a multimedia presentation. For example, the use of a blue background with white text is an example of a widely applied colour scheme for web pages of high-tech companies. In the graphic design communities, various heuristic principles have been proposed for developing colour schemes that tend to invoke a particular style or emotion[4]. A number of systems have been reported to automate the design of colour schemes. For example, Tokoumaru, *et al.*[5] proposed a system that automatically composes affective colour schemes mainly based on principle of colour harmony. A more easily accessible resource for the colour schemes is the colour charts that explicitly enumerate the colour schemes to different styles or affective states[6].

To provide a better visual structure of a multimedia page, in practice, a direct way for applying the colour schemes is to segment the page canvas, based on a layout design, into multiple coloured regions each one with a particular colour in the desired colour scheme. Alternatively, for applications that emphasise the aesthetics of the presentation, a more appealing way is to incorporate a background image design based on the concerns of both the layout and colour schemes. Usually, an exhibition author would select background images that are pertaining to the major theme of the exhibition content. For example, an exhibition regarding an artifact of ancient Chinese culture would typically apply images such as Chinese landscape paintings as the background. Often, in a common practice in multimedia design communities, the image would be manipulated offline in priori to incorporate certain layout design and colour schemes to create desired aesthetic or emotional effects. Our interest is to develop an intelligent system with which an exhibition author could facilitate the background image manipulation online with ease. The following describes a computationally efficient approach to achieve such a goal. The concern here is to transform the colour profiles of an image with a balance between the original visual characteristics of the image and the target colour scheme that is associated to a particular style or affective state.

Roughly speaking, our approach first transforms the input image to grayscale. Then, based on the colour assigned for each region in the page layout, the colour tone of an output pixel is changed to that of the target colour, while the saturation and brightness of the pixel are changed based on the brightness of the input pixels according to a number of heuristic rules. These heuristic rules were manually tuned mainly to achieve an optimal contrast of the manipulated image. Figure 2 illustrates a typical colour manipulation process in the proposed intelligent background image composition module. The detail colour transformation algorithm is elaborated in Table 1.

In a bitmap image, the colour of an image pixel is represented by a colour vector representing values in a corresponding constitutes of a certain colour models. The HSB (Hue, Saturation, Brightness) model is commonly used in computer graphics applications[7]. The HSB colour space was designed to approximate the way humans perceive and interpret colour. The model defines a colour space in terms of three

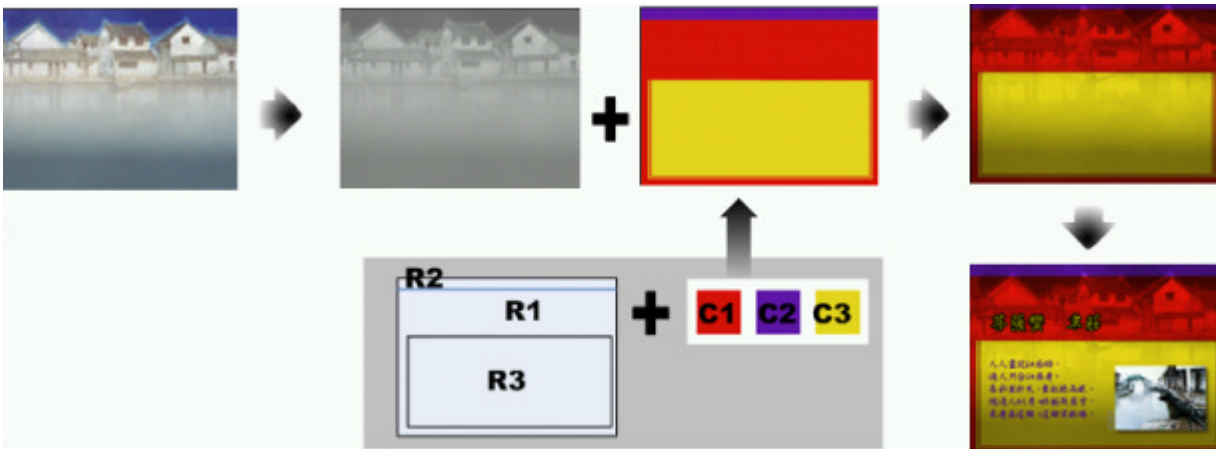

Figure 2. The colour manipulation process in the background composition module.

Table 1. Algorithms for the colour transformation

Step1:	Transform each pixel in the input image from RGB colour to grayscale with the luminance B_{in} given as [5] $B_{in} = 0.299R + 0.577G + 0.144B$
Step 2	Perform Gamma correction on the grayscale pixel. $Bg = B_{in}^{\ g}$ where g is set to 0.5 for presentations to be shown in typical LCD monitors.
Step 3	Based on the target colour (H_{target}, S_{target}, B_{target}), perform colour transformation according to the following heuristic rules. (H) The hue of all the pixels is set the target hue. $H_{out} = H_{target}$ (S) The saturation of pixels with the gamma-corrected brightness less than 0.5 is set to the target saturation. Others are linearly decayed $S_{out} = \begin{cases} S_{target}, & 0 < B_g \le 0.5 \\ 2S_{target} - 2S_{target} \times B_g & 0 < B_g \le 1 \end{cases}$ (B) The brightness of a pixel is linearly mapped based on the target brightness (B_{target}) and a given contrast span (ΔB) $B_{out} = B_{target} - 0.5\Delta B + \Delta B \times B_g$

constituent components, namely, hue, saturation, and brightness. Table 1 lists a computationally-efficient algorithm based on the HSB colour models for manipulating the colours of a background image to better fit to a target colour scheme.

Based on the above principles, Fig. 3 illustrates the framework of the background image composition module which includes the following core elements.

Image Bank: The layout bank contains a collection of colour images to be used as the background of a multimedia presentation.

Affective Colour Scheme Generator: The colour schemes for a particular style or affective state can be dynamically calculated using various colour combination heuristic rules, or simple based on colour scheme charts.

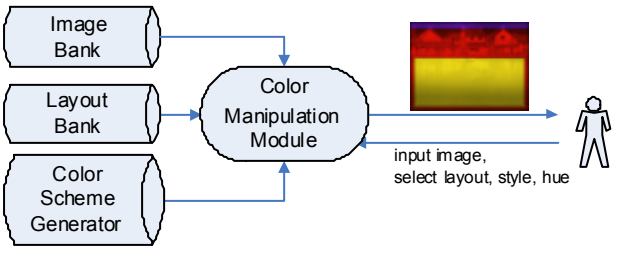

Figure 3. Framework of the background image composition module.

Layout Bank: The layout bank contains a collection of layout designs each one with a particular arrangement of sub-page regions for the presentation. The layout schemes need to be pre-fabricated by graphic designers.

Colour Manipulation Module: This module handles the computation for the on-the-fly image manipulation. The image manipulation could be implemented either in the server-side or in the player-side, depending on the image processing capabilities of the player.

User Interface: The user interface allows a user to select the target style or affective state, layout, colour schemes, and background image.

4. IMPLEMENTATIONS

Based on the proposed framework, we have implemented a prototype system. We applied the Macromedia Flash technology for implementing the layer presenters. Each layer presenter is essentially a self-contained Flash document, in which the formatting, interactions and decorative graphics are all encapsulated. Flash provides a layer-based architecture with which a presentation with different graphic elements can be easily superimposed one upon one seamlessly. Particular, since the plug-ins for Flash player have been extremely widely installed, a user would not have to download additional plug-ins to view the developed exhibitions. For the server-side content

management and on-the-fly image manipulations, we applied the Microsoft ASP.net and SQL database technologies. In our design, the system provides a "PowerPoint-like" interface, with which a typical content author with basic computer skills can operate easily. Figure 4 shows snapshots of the interfaces, with which a user can organise the content structure of an exhibition page, input text (HTML or plain text), select the animation parameters, adjust the position and transparency of each layer, and preview the presentation. Figure 5 shows a snapshot of the interface for the background image composition module. Figure 6 shows a snapshot of exhibition pages for a content document with three different presentation styles.

The system adopted the colour combination schemes listed by Colour Research Institute, Korea[6]. About a dozen of common style or affective states, each one with five colour schemes were applied. Dozens of different layouts were designed. A typical process for generating a colour-transformed background image includes the following steps:

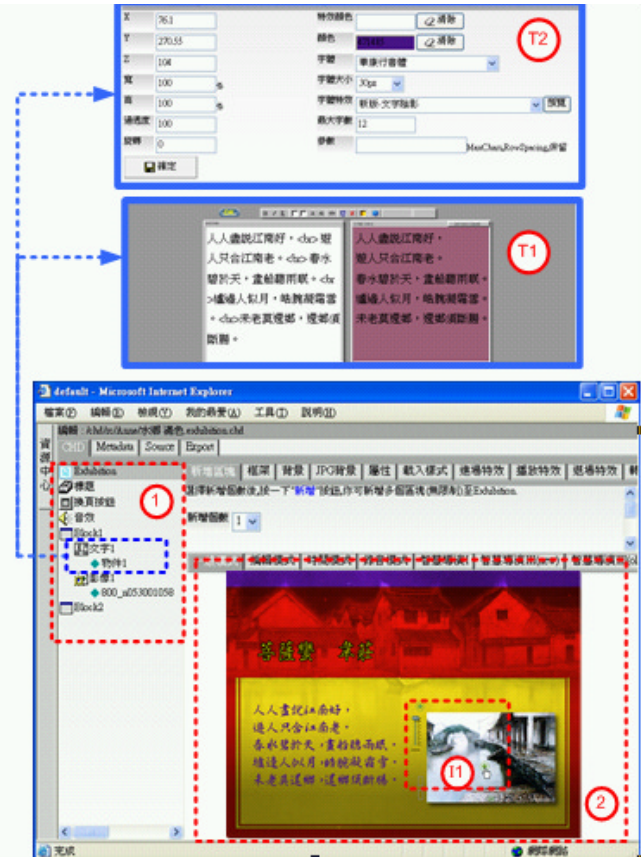

Figure 4. Snapshots of the system interfaces: (1) content structure; (2) preview of the presentation; (T1) HTML-based interface for content texts; (T2) interface for setting the parameters of the text layer presenter; (I1) WYSIWYG interface for adjusting the size, position, and transparency of the image layer presenter.

Step 1. Select a background image and a layout.

Step 2. Select a target style or affective state.

Step 3. Select a colour scheme associated with the target style or affective state.

Step 4. Based on the selected colour scheme and layout, the final background image is dynamically composed.

Step 5. Finally, the content layers are superimposed on top of the composed background using corresponding layer presenters. The position, rotation, and transparency of each layer can then be adjusted to fit to the selected background layout.

5. A CASE STUDY ON THE SYSTEM USABILITY

The implemented system has been used in two of our digital museum projects for construction of the exhibition websites of the Lanyu Digital Museum and the National Repository of Cultural Heritage. Each exhibition website contains hundreds of exhibitions, which are constantly updated from time to time. The exhibitions were authored alone by a professional graphic designer skilled in Photoshop and PowerPoint but not in Macromedia Flash or programming. He found that the system interfaces resemble that of the PowerPoint and is rather easy to learn and operate. It took a number of hours to get familiar with the interfaces. Overall speaking, the quality of authored animation-based presentations is rather satisfactory. Figure 7 shows a snapshot of the exhibitions for the two projects (note that animation of the presentation could not be captured in these steady shots).

Nevertheless, observations on the authoring processes of the author pointed out a main problem that is related to the usability of the system. Aiming to provide versatile presentation styles, we devoted a significant amount of resources to develop huge amount of layer presenters, audio loops, and together many presentation parameters that a user can select and adjust. It appeared that there were many good layer presenters that have never been used throughout the projects. How to develop interfaces to help content authors to efficiently locate the appropriate layer presenters in such a large pool to give a desired target style to be explored. In the long run, given a system with such complex functionalities supported, there are several dimensions along which this system should be evaluated. It would require

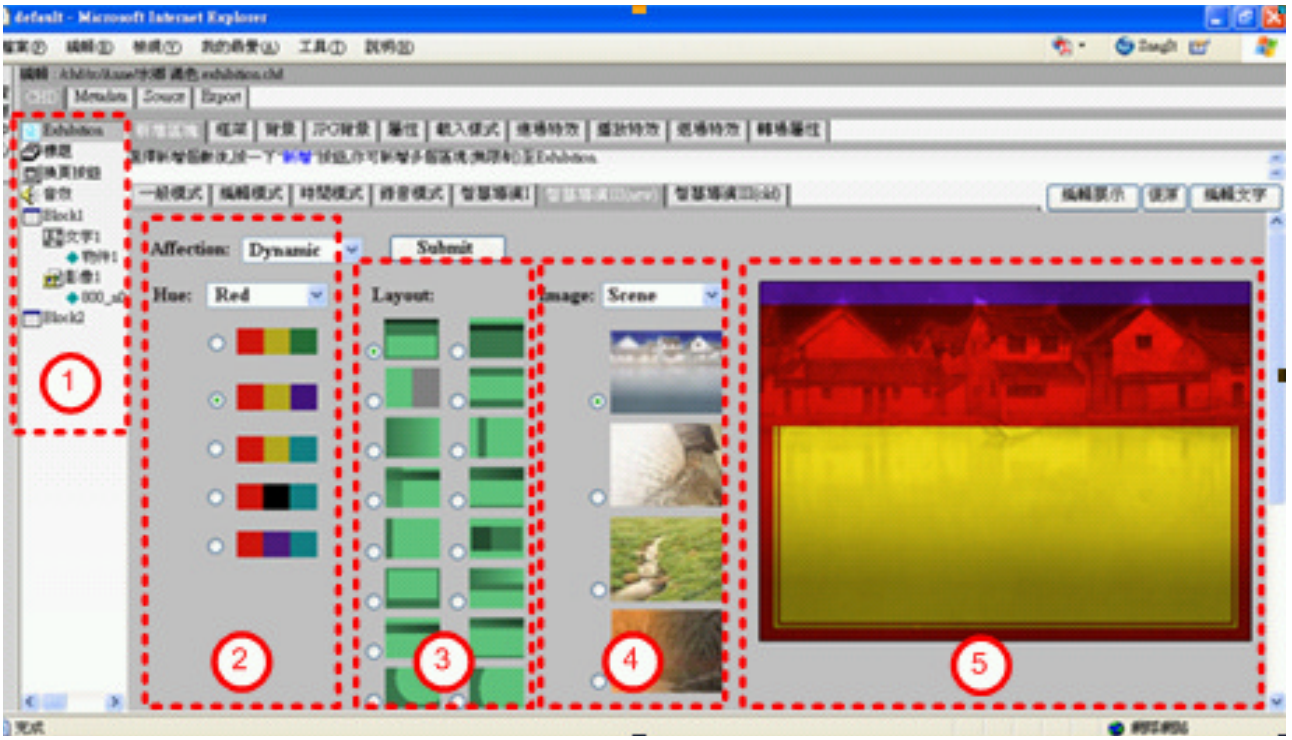

Figure 5. A snapshot of the interface for the intelligent background image composer. (1) content structure; (2) affective colour schemes; (3) layout; (4) images; (5) preview of the composed background.

Figure 6. A snapshot of exhibition pages for a content document with three different presentation styles.

Figure 7. A snapshot of the exhibition website for the Lanyu Digital Museum (left), and a snapshot of the exhibition website for the National Repository of Cultural Heritage (right).

a full-fledged usability test to justify various aspects of the system such as functionality, user interface, aesthetic and affective performances, and potential applications. The more serious study on the usability is current under our research agenda.

6. CONCLUSION AND FUTURE WORK

This study addresses the development of an online authoring system that can be integrated into a digital archive system to help the content author to facilitate the construction of online exhibitions. The system is build upon a layer-based hypermedia presentation architecture, which decomposes a style template into several independent layer presenters. Particular attention has been focused on the approach for a background composition module that incorporates the concerns of affective colour schemes and page layout.

The proposed layer-based approach appears to be practical in current web environments for authoring large-scale aesthetic and affective exhibitions. Nevertheless, while the proposed system could be widely applied in authoring scenario where human intervention is available, our optimal goal is to develop an intelligent-styling system that can create an affective exhibition based on properties of a content document in a more automated way. The relevant research is currently under study in our research group.

ACKNOWLEDGMENTS

This work is supported by the National Science Council of Taiwan, under grant NSC-94-2422-H-260-002.

REFERENCES

1. Hong, J.S.; Chen, P.H. & Hsiang, J. XSL-based content management for multi-presentation digital museum exhibitions. *In* ECDL2001: 5th European Conference on Research and Advanced Technology for Digital Libraries, Darmstat, Germany, September 2001.

2. Yang, R.; Ramaiah, C.K. & Foo, S. Virtual archival exhibition system: An authoring tool for developing web-based virtual exhibitions. *In* Proceedings of the International Conference on Dublin Core and Metadata Applications, 2007, pp. 96-105.

3. Kim, J.; Lee, J. & Choi, D. Designing emotionally evocative homepages: An empirical study of the quantitative relations between design factors and emotional dimensions. *International Journal of Human-Computer Studies*, 2003, **59**(6), 899-940.

4. Itten, J. The art of colour: The subjective experience and objective rationale of colour. John Wiley & Sons Inc, 1997, ISBN-13: 978-0471289289.

5. Tokumaru, M.; Muranaka, N. & Imanishi, S. Colour design support system considering colour harmony. *In* Proceedings of the 2002 IEEE International Conference on Fuzzy Systems. IEEE Press, Honolulu, 2002, pp. 378-383.

6. I.R.I. Colour Research Institute, Korea. Colour Combination. Youngjin.com & Co., ISBN: 89-314-2368-3, 2003.

7. Jain, A. Fundamentals of digital image processing. Englewood Cliffs, Prentice-Hall, N.J., p.67. ISBN: 0-13-332578-4, 1989.

About the Authors

Dr Pai-Hsun Chen received her MS degree and the PhD degree in computer science and information engineering from the National Chi Nan University in 2001 and 2005, respectively. In August 2005, she joined the Department of Computer Science and Information Engineering, Nan Kai Institute of Technology, Taiwan, as an assistant professor. Her research interests include digital museum, hypermedia, affective computing and aesthetic computing.

Dr Jen-Shin Hong received his PhD degree from the University of California at Berkeley in 1993 with bioengineering/mechanical engineering major. He is currently an associate professor in the Department of Computer Science and Information Engineering at National ChiNan University, Taiwan. He has served in the editorial board of the International Journal on Digital libraries since 2002. His research interests are in digital library systems, hypermedia authoring, affective computing and affective computing.

Dr Sheng-Wen Shih received his MS and PhD degree in electrical engineering from the National Taiwan University in 1990 and 1996, respectively. From January to July 1997, he worked as a postdoctoral associate at the Image Formation and Processing Laboratory, Beckman Institute, University of Illinois. In August 1997, he joined the Department of Computer Science and Information Engineering, National Chi Nan University, Taiwan, as an assistant professor, and became an associate professor in 2003. His research interests include computer vision, biometrics, and human-computer interaction.