



Image Processing Design and Application of the Digital Museum Based on Jinling's Compendium of Materia Medica

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Abstract. The report made on the Chinese Communist Party's 20th National Congress in 2022 calls for promoting health development as well as the inheritance and innovation of traditional Chinese medicine. Allowing for the enormous theoretical and practical value of the ancient Chinese medicine book titled "Compendium of Materia Medica", this paper elaborates on the digital practice process from the perspectives of image science, computer application science and design science. Through the design framework and preliminary construction of "Compendium of Materia Medica" digital museum, the digital database is selected as the core to digitize and innovate the images in Jinling's "Compendium of Materia Medica", as elaborated on from various perspectives like the digital collection of images, the processing of visual image information and image interaction. "Compendium of Materia Medica" enables the digital transformation of images, while digital museum offers the audience a novel form of service and demonstrates the concept of interactive development.

Keywords: Compendium of Materia Medica · digital museum · image processing · digital design

1 Introduction

In the context of global digital media, the audiences increasingly collect information through mobile clients and other emerging types of media. Traditional Chinese medicine culture disseminators make use of pictures, audio materials, video and other means to convey the theoretical value and cultural connotation carried by traditional Chinese medicine. Image is one of the forms taken by visual design and information transmission. As a new member of the image pedigree, digital image is usually characterized by non-materiality, which makes it one of the visual presentation methods as a result of the simultaneous development of image technology and media technology [1]. Since the content of Compendium of Materia Medica is more professional than that targeted at the public, its dissemination is restricted to a certain extent. In order to achieve effective and extensive dissemination, the Jinling version of Compendium of Materia Medica is taken as the research object in this paper to establish a digital museum based on mass communication. Through an image-oriented presentation, traditional images are integrated

with digital technology to create an interactive and diversified virtual experience place. Breaking the limits of time and space through various media terminals, “Compendium of Materia Medica” digital museum presents the images of Jinling’s “Compendium of Materia Medica” through the application of digital processing technology. In this way, a complete system is constructed to transform the expression and dissemination of traditional Chinese medicine culture.

2 Image Application and Artistic Features of Jinling’s Compendium of Materia Medica

Known as the “Encyclopedia of Ancient China”, Compendium of Materia Medica contains numerous images of drugs, which achieves the intuitive expression of the specific forms of drugs while promoting their dissemination and interpretation. Officially published in Nanjing in 1593, the Jinling version of Compendium of Materia Medica was written by Li Shizhen, a prominent medical scientist of the Ming Dynasty. Regarded as the ancestor of Compendium of Materia Medica, it includes a total of 52 volumes. Volume 2 contains 1109 pictures, 25 volumes and 4 letters [2]. A vast majority of the images are manually drawn and written in a style closer to the traditional Chinese white painting, involving the techniques of woodcut letterpress printing and Yang engraving. Due to the promotion of “no knife marks, no engraving” in the Ming Dynasty, the woodcut illustrations of Jinling were carved on wooden boards, but they differed from modern woodcut prints. Not only do plant images need to be intuitively understandable for the audience, they are also required to reflect the specific medicinal properties and applications. For this reason, the image is placed in front of the text, which allows the audience to better view the image and the characteristics of medication before and after [3]. The subsequent Jiangxi edition and Hangzhou edition are the reprints of the original Jinling edition.

3 The Key Technology and Design Framework of “Compendium of Materia Medica” Digital Museum

The digital museum of “Compendium of Materia Medica” focuses mainly on expressing the content essence and cultural connotation of Jinling’s “Compendium of Materia Medica”, so that it becomes more easily understandable to the world. For the domestic and foreign traditional Chinese medicine fans and researchers service, network information technology is applied to build a unique brand of “Compendium of Materia Medica” digital museum for integrating popular science, education, scientific research, clinical, aesthetic and design sense. Through the construction of a service platform targeted at the public and a digital asset management system combination portal, which functions as the main exhibition and application place of digital achievements, visitors can view a large number of various contents presented by the relevant digital museum websites online [4].

Java is used as the underlying software design, and B/S architecture is used to realize the data management of text, image and audio. The client is written in HTML5, the

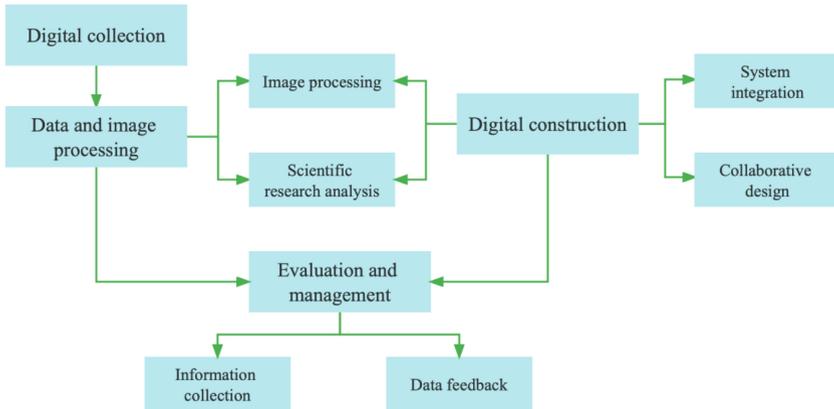


Fig. 1. The process of the “Compendium of Materia Medica” digital museum construction

server uses MySQL database, the application server middleware uses Tomcat, and the Web server uses Apache. The process of the digital museum construction is divided into four steps, which are digital collection, data and image processing, digital construction as well as evaluation and management (see Fig. 1). The functional section of the website mainly includes overview tour, digital database, virtual exhibition hall, academic science popularization and cultural topics [5]. This paper takes the digital database as an example to illustrate its functional design process with images as the main practice mode.

4 The “Compendium of Materia Medica” Digital Museum Image Processing Presentation

4.1 Traditional Digital Acquisition of Plant Images

Image is the main presentation mode and expression content of the database section in the digital museum. Enshi City of Hubei Province was selected as the sample collection site, and more than 20 million digital cameras were used for basic digital photography image collection, which could be performed from two perspectives: outdoor and interior. Outdoor collection is aimed primarily at the collection of the source of medicinal materials, which shows the appearance of the plant itself. Interior collection covers medicinal materials, decoction pieces, plant waxy leaf specimens, impregnated plant specimens, etc., which makes a portrayal of medicinal parts. Based on the theory of computer vision, the features of the collected images were analyzed, and the characteristics and applicability of the image analysis algorithm were integrated to establish the quantitative feature parameter system of plant images [6]. The images taken were imported into photoshop and uniformly cut into a 1:1 composition ratio and a resolution of 330 × 330, and folders were established and stored according to the classification of the original works.

4.2 Equalization of Color Histograms of Plant Images

Color histogram equalization is an important step in image processing. Suppose that $M(x_i)$ is the number of pixels of a certain characteristic value of the image, and

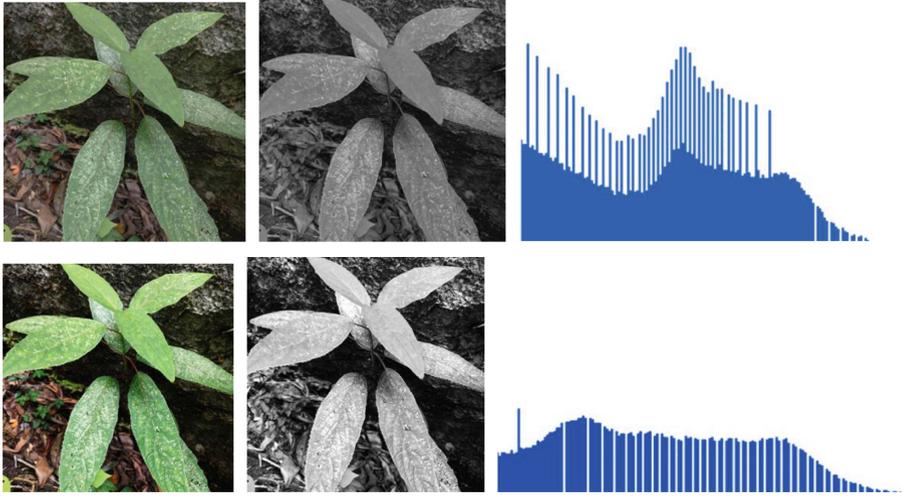


Fig. 2. Comparison of equalized images and histograms

$N = \sum_1 M(x_i)$ is the total number of pixels of the image. Then, the $M(x_i)$ is normalized as:

$$H(x_i) = \frac{M(x_i)}{\sum_1 M(x_i)} = \frac{M(x_i)}{N} \quad (1)$$

The color histogram of the characteristic value in the image is $H(\text{image}) = [h(x_1), h(x_2), \dots, h(x_n)]$, where “n” is the number of values of a feature. In short, the color histogram is the probability distribution of a certain feature of the image [7]. Histogram equalization is to convert the color level histogram distribution of digital images into approximately uniform distribution, so as to normalize the image intensity, achieve the purpose of image enhancement, and improve the uniformity and image quality of the information transmission of pictures collected in the “Compendium of Materia Medica” digital museum [8].

Take the green leaf photographed under natural light as an example, which belongs to the 16th volume of Jinling’s Compendium of Materia Medica. The original image and color histogram are shown above in Fig. 2. In order to more directly reflect the effect of histogram equalization, the image is converted to grayscale at the same time. The horizontal value of the histogram ranges from 0 to 255, representing pixel values, and the vertical value represents the number of pixel values in the entire image. In addition, histogram equalization is used to balance and adjust the image brightness, which can enhance the local contrast of the image without affecting the overall contrast of the image [9].

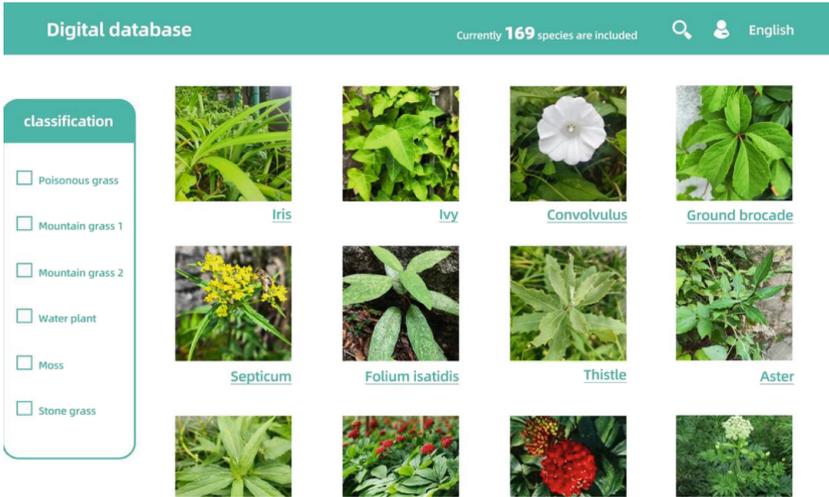


Fig. 3. The home page of the digital database of “Compendium of Materia Medica” digital museum

4.3 The Function Design of Image Application

The uniformly processed plant images are applied to the main components of the digital museum database. Users can control the prompts through the computer mouse according to their needs and click on different kinds of herbs to receive information transmission, including plant names, plant images, medicinal material map, medicinal effects and decocting methods, as shown in Fig. 3.

Image interactive design is integrated on the basis of information science popularization. Different parts of some plants have different effects. For example, the head of *Angelica sinensis* can be used to replenish blood, while the side part has a strong effect of promoting blood circulation and relieving pain. 3D max modeling software is used to complete the model production of Chinese medicinal materials through geometry modeling processing, turning and image texture mapping technology, and then import the Touch Designer [10]. Users can not only manually rotate the direction of the screen to observe the object display from all angles, but also use the touch click of the setting to obtain the relevant practical information, as shown in Fig. 4.

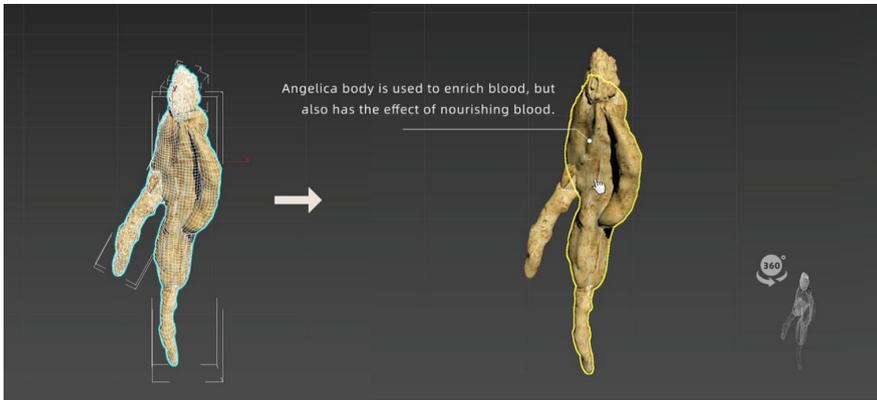


Fig. 4. “Compendium of Materia Medica” interaction with 3D images

5 Conclusion

The core idea adopted by the digital museum of “Compendium of Materia Medica” is to build an information resource base according to the Jinling version of Compendium of Materia Medica through digital image technology. It plays an important role in addressing the lack of Chinese local cultural information on the Internet, and in promoting the penetration, radiation and attractiveness of traditional Chinese medicine culture. The construction of digital museum contributes to breaking the barriers between traditional museums and the sharing of cultural essence by all human beings. It represents one of the important directions of development for digital museums to achieve the image communication and interaction through the design and presentation of image processing technology. Therefore, ordinary members of the audience can independently discover history and experience cultural traditions. The application of digital image design and technology is not only the study of design methods, but also the study of digital image language strategy and practice as a design medium. The digital museum of “Compendium of Materia Medica” also provides the audience with a brand-new service mode and development concept.

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