International Journal of Signal Processing, Image Processing and Pattern Recognition
Vol.9, No.5 (2016), pp.281-290
http://dx.doi.org/10.14257/ijsip.2016.9.5.25

# Preprocessing and Edge Detection of Natural Images and Computer Generated Images

Yan Wang[*1] and Xiao Wang[2]

[1]*Center of Modern Education Technology, Xinxiang Medical University, Henan Xinxiang, 453003, China*
[2]*The Computer Center, Xinxiang Medical University, Henan Xinxiang, 453003, China*
*E-mail:wy@xxmu.edu.cn*

***Abstract***

*Digital image tamper detection by analyzing the statistical properties of the image content of the authenticity of the digital image, the scene authenticity and integrity of authentication methods, namely determine whether the image is the original image, whether the image is real and whether it contains other secret information image, these techniques is the digital image forensics. Digital image forensics technology is dependent on the basis of the original carrier may be divided into active and passive two technologies forensics evidence. This paper generated image detection research for digital image forensics scene authenticity certification in natural images and computer. Combining the results of recent research, based on systematic analysis of the differences between two types of image generation, high-end features for wavelet conducted a detailed study of the effectiveness, from the validity of the characteristic data, proposed several general-purpose computer generating an image detection algorithm. Compared with the previous detection algorithm, strong stability of the proposed algorithm, computational complexity is low, and has easy implementation.*

***Keywords***: *Natural image; wavelet transform; high-end features, image processing; image pre-processing; image filtering*

## 1. Introduction

Digital image and its intuitive features very convincing, has become our life and work of one of the most major of access and publish information [1]. It is as an effective carrier of information transmission, is widely used in marketing campaigns, news and information services and other network environments, some non-network applications such as video surveillance, criminal investigation, criminal investigation, also plays an increasingly important role [2-3]. Along with the development and application of image processing technology, image optimization technology is also widely used in people's daily lives, in some extent to meet the people's needs. But some criminals malicious use of image processing techniques (image-tampering technology) as the assault groups, crime tool. Tampering with images of abuse so weakened credibility of the law, science and the authenticity of the news media under suspicion, the international political and social stability is compromised [4-7]. Therefore, the study carried out image tamper detection technology is of great significance for maintaining the validity and authenticity of the image data, and to ensure the integrity, the interests of justice and the fight against crime.

[*]Corresponding Author

ISSN: 2005-4254 IJSIP

Existing research results also less, the proposed algorithm versatility also poor, often only for specific tamper technology. And because of the diversity of tampering technology and easy to combine, resulting in tamper detection algorithm targeted too, and the development is lagging behind. Therefore, the general direction of the detection algorithm is tamper detection technology [8]. Currently, some detection algorithms due to the high computational complexity, inefficient and can not be put into practical application, raise a key issue in performance detection algorithm is to be solved. In addition, most algorithms strong dependence on the training sample if there is no tampering support a large number of images and the original image training test library, according to the statistical properties of the image detection algorithm will lack reliability, thus establishing a standard tamper image library of great significance [9-10]. At present, the development of passive forensics technology is still in its infancy, many problems still to be resolved.

With the rapid development of information technology and a variety of production techniques continue to improve and improve, computer generated images and natural images approximate perfection, the naked eye is difficult to identify these images off, which exacerbates the real images and computer-generated image detection difficulty. So natural images and computer-generated images to identify problem has become an important topic in the field of information technology. Feature in the form of data to express themselves through the data to exert its effectiveness. Data is significant digits to reflect the accuracy of the data, if a sufficient number of significant digits will be able to better reflect the characteristics of effectiveness. Therefore, the validity of the analysis of the characteristics of data validity, give full play to the characteristics of one of the breakthrough research. This article is in the passive forensics framework of digital image forensics technology deployment, focusing on the image of the scene authenticity certification, which is natural images and computer-generated image detection classification.

## 2. The Basic Concept of Images and Digital Image Processing

An object image is an objective similarity of imitation and description of objects is an incomplete, inaccurate description, but in some sense it is appropriate representation [11]. Image plays a very important role in human perception, people virtually anywhere at anytime exposure to various images. According to statistics, in humans all the information received, the visual information accounts. As the saying goes, "seeing is believing", in many cases, the information contained in the image to be richer and more real than any other form of information. As can be seen, the image information is very important.

Image is usually from an intuitive sense and its meaning, for example, the image on the retina of the human eye, or digital camera captured images. With a definition can be described as: an objective image of the object is similar in nature, the description or pictorial vividness. Image is an objective representation of the object, which contains information about the object being described, it is the people's main source of information. It is believed that the two concepts are closely related with the image pictures and graphics. Image is a type of image, which is defined as the distribution of visible light after a suitable object [12]. Custom graphic is corresponding mathematical engineering or architecture graphics technology, it stressed in a certain mathematical base model up to generate graphics. It should be noted that the different graphics and image data, using the vector graphic structure, and the image grid structure is used. Depending on the image can be formed, resulting in classification and treatment methods. From the point of view of set theory, if the image classification is shown in Figure 1.

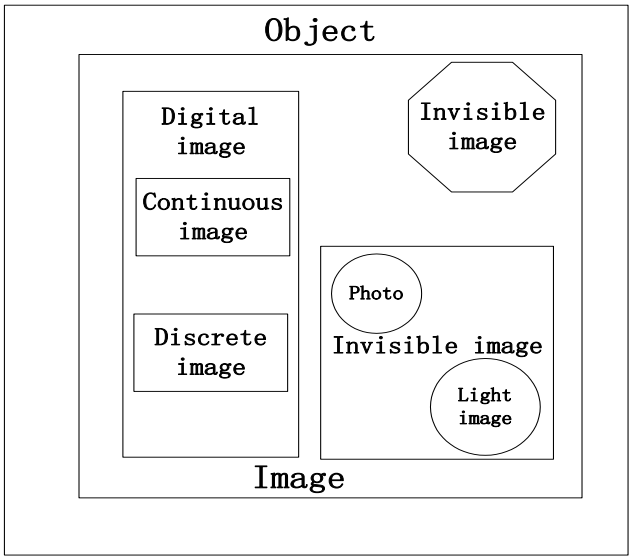



**Figure 1. Classification of Images**

Due to the amount of information contained in the digital image is huge, and therefore requires a computer system or embedded system computing speed, large storage capacity (including memory and external memory), as well as strong software capabilities. The image processing system uses different, you can use different image processing systems, from embedded systems can carry to the microcomputer and then to mainframe computers; can be a single processor, you can use multiple processors constitute an array or network group. Information processing dedicated image processing system often consists of one or a few slices of dedicated chip to complete [13-15].

Figure 2 is a block diagram of a general purpose digital image processing system. The image input device can be used cameras, scanners or other semiconductor devices and the like. They have their own characteristics in the way information is collected, the spatial resolution (image precision), the speed of capture information, etc., can be selected according to need. Sometimes a generic digital image processing system can also simultaneously support the use of several image input devices to meet the needs of different situations. An image input device typically plays the role of the photoelectric conversion. Obtaining an analog electrical signal corresponding thereto according to the light intensity of the image information into analog electrical signals required in the ADC output can be converted to a digital image by a computer (embedded system) to identify. ADC sampling and quantization by the two parts, generally consists of a dedicated analog-digital conversion circuit or chip to complete. Some image input device that is already included in the ADC output digital signal directly, you can connect directly to a computer via a digital interface (embedded systems).

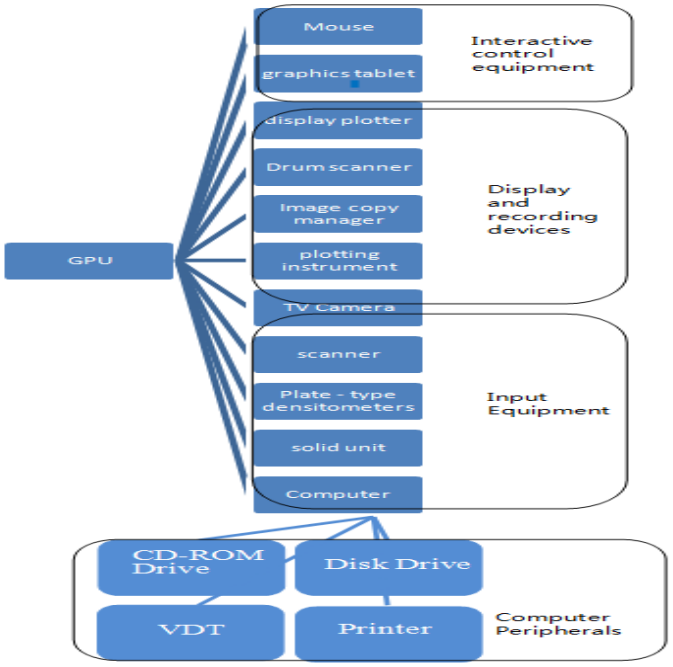



**Figure 2. Block Diagram of General Purpose Digital Image Processing System**

## 3. Computer Image Detection Algorithm

*A. Formation mechanism of natural images and computer-generated image*

(1) Natural image formation mechanism

That is a natural image digital photo digital camera. Digital camera as fashion digital products, its powerful features, easy operation and excellent shooting, by the majority of consumers.

When the scene before the light reaches the sensor, it must also pass an anti-aliasing filter lens, then through the color filter array CFA (Figure 3). CFA is a mosaic color filter array is formed by the color filter array, each pixel location in one color only allowed through the barrier by the other two color frequencies. Applications CFA color image sensor array, the pixel values must be obtained by using the interpolated operations, access to the three primary colors at each pixel location information obtained color values but also for general operations such as color correction and white balance. In order to enhance the effect of digital images visually, it must also be a linear image sensor and the kernel filter is adjusted in response to the additional processing on the image further comprises a gamma correction. Finally, according to the digital image to the user selects a file format (such as JPEG) writes a digital camera's memory devices.

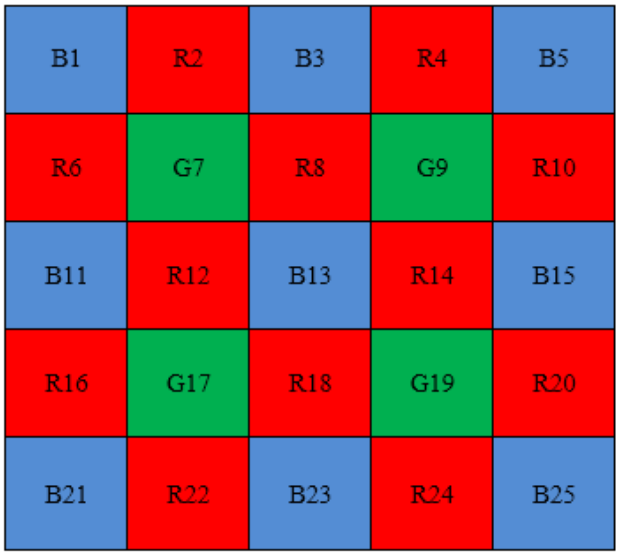



**Figure 3. CFA Color Filter Array**

(2) Computer image generation mechanism

Computer-generated image is constructed to reproduce the real or virtual scene by scene computer software and get realistic graphics. It first described the scene to establish the geometry representation, and then to generate photorealistic images by simulating the physical properties of the optical properties of objects, texture characteristics, and the positional relationship between objects and the like. A complete computer-generated image generation technology (Figure 4) includes the following components:

a. The modeling technique (modeling): structural model based on the needs of the scene, including the body of said structure and operations.

b. Realistic graphics generation technology: realistic image synthesis technology is the three-dimensional model of the object in the form of two-dimensional image projected onto the display screen.

c. Interactive technology: human-computer interaction, the image is perfect to reach the vivid effect.

*B. Image acquisition card*

To the analog signal into a computer can recognize and deal with the digital signal, you must have the appropriate image acquisition devices, the most common image capture device is a frame grabber. Image acquisition card is to convert analog video signals into digital signals specialized equipment, while digital signal when the input image processing module is not required to use an image acquisition card, can be directly fed.

Image capture card, there are many types, according to the activity of the image can be divided into still images and moving image capture card capture card, the main difference is the moving image capture card in addition to the general and still image capture card the same static image capture function outside, it also has a continuous video capture and video storage function; depending on the system in the camera, and can be divided into color images and black and white images capture card capture card, the difference between the two is a color image acquisition card in addition to the collection of black and white images outside can capture color images; image acquisition card can also be divided into surface scanning image acquisition card and line scan image capture card, the difference is the way the work area scan image capture card is face scan, line scan image capture card is input to an analog signal by line scanning (Figure 4).


**Figure 4. Image Acquisition Module**

*C. Image preprocessing*

The actual site of the acquisition process, the resulting image is often the color image, but the desired color image storage capacity, computational complexity, but in many practical applications, storage capacity and computing capacity to be much smaller gray image to meet Claim. For the color of each pixel in the image, we have taken the following formula to convert it into a 256-color grayscale.

$$I_{(x,y)} = 0.31R + 0.59G + 0.1B \tag{1}$$

Gray value equation, I (x, y) coordinates on behalf of the figure (x, y) of the pixel.

Neighborhood averaging method is noisy original image f (x, y) of each pixel takes a neighborhood S, averaging S gray values of all pixels as neighborhood average after treatment the new gray value image g (x, y) of the pixel, namely:

$$g(x,y) = \frac{1}{M} \sum_{(i,j)\in S} f(i,j) \tag{2}$$

An image M×N through a process of the m × n weighted mean filter is given by:

$$g(x,y) = \frac{\sum_{s=-a}^{a} \sum_{i=-b}^{b} w(s,t) f(x+s, y+t)}{\sum_{s=-a}^{a} \sum_{i=-b}^{b} w(s,t)} \tag{3}$$

Under normal circumstances, choose a different template to eliminate different noise. The template can be realized with the image so convolution smoothing purposes. Common templates are:

$$\frac{1}{8}\begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 1 \end{bmatrix} \quad \frac{1}{9}\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix} \quad \frac{1}{10}\begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 1 \\ 1 & 1 & 1 \end{bmatrix} \tag{4}$$

## 4. Experimental Results

A. *Image multi-wavelet and filtering*

Since Multiwavelet can only transform vector signal, therefore, the scalar signal such as image data must be converted for multi-vector signal to wavelet transform. First, using the method of the scalar parity signal x (m), m = 1,2,3 ... N into vector signals.

$$X(n) = \begin{pmatrix} x(2n-1) \\ x(2n) \end{pmatrix} \tag{5}$$

In this paper, a result of GHM multiwavelet the image conversion, so using conventional GHM multiwavelet pre-filter. GHM multiwavelet pre-filter coefficient matrix structure is as follows:

$$\Pr e(0) = \begin{bmatrix} \frac{3}{8\sqrt{2}} & \frac{10}{8\sqrt{2}} \\ 0 & 0 \end{bmatrix} \tag{6}$$

$$\Pr e(0) = \begin{bmatrix} \frac{3}{8\sqrt{2}} & 0 \\ 1 & 0 \end{bmatrix} \tag{7}$$

$$F(n) = \sum_i \Pr e(k) x(n-k) \tag{8}$$

Wherein, P (0), P (1), F (n) denote the vector signal pre-filter coefficient matrix and the pre-filtered.

*B. The simulation experiment*

In this study, an image library contains 800 computer-generated images and 800 natural images, in which 800 natural images and some computer generated images and real images from the Columbia University computer-generated image database, another part of the computer-generated imagery from several well-known computer generating an image sites such as 3dlinks, 3dshop, 3dtotal, gallery rhino and so on.

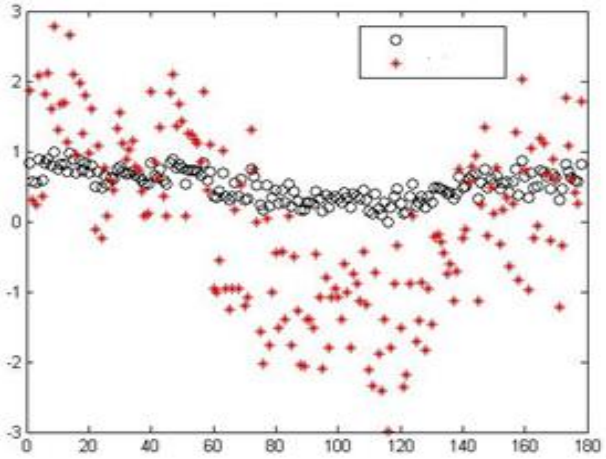



**Figure 5. Normalization Method Comparison Chart**

Stability refers to the prediction model is in a stable range, without being affected by a first randomized trial in the training set and prediction set ratio of 4: 1 Condition experimental random test carried out 10 times. Figure 5 shows normalization method comparison chart, accuracy stable at around 92.5%, TP stable at around 94.1%, TN stable at around 91.0%, three recognition rate are in a stable range, stability of the method can be seen very well.

*C. Effect of high-frequency and low-frequency sub-band on the test results*

Results wavelet transform is to convert the image from the spatial domain to the frequency domain to obtain a level of high-frequency sub-bands, vertical and diagonal high-frequency sub-band high-frequency and high-frequency sub-band image sub-band image, high frequency can be divided into frequency sub-bands. Each sub-band reflects the different characteristics of the image, the low-frequency sub-band image that reflects the rich content that is close to the entire image content; the level of high frequency sub-band refers to the high frequency spectrum of the image in the horizontal direction, reflected image in the horizontal direction details; vertical high-frequency sub-band refers to the high frequency spectrum of the image in the vertical direction, reflecting the image detail in the horizontal direction; diagonal high-frequency sub-band refers to the high frequency spectrum on an image diagonal direction, reflect Image details in the direction of 45 degrees and 135 degrees direction; in short, reflect the low frequency sub-band approximation of the original image, the high-frequency sub-bands reflect more details.

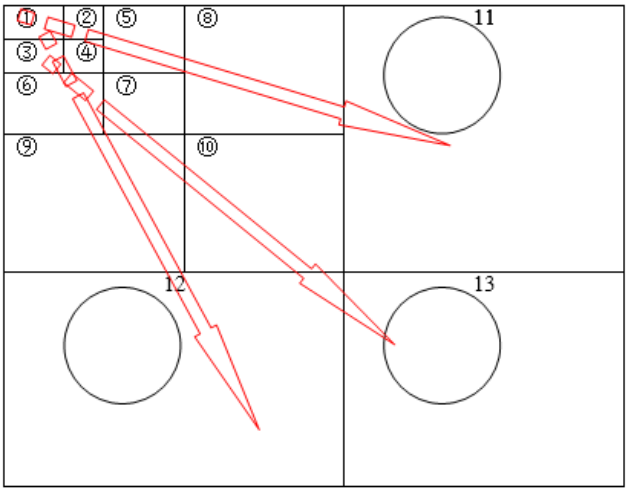



**Figure 6. Fourth Order Wavelet Transform Exploded View**

Figure 6 shows an image of Fourth Order 13 sub-band wavelet transform obtained, where 1 is the low-frequency sub-bands, the rest are for the high frequency sub-band, 2,5,8,11 for the horizontal high-frequency sub-band, 3 , 6,9,12 the vertical high-frequency sub-bands, 4,7,10,13 a diagonal direction high frequency sub-band.

In order to verify the theory proposed, we made the following experimental results shown in Table 1. Experimental individual orders of high frequency sub-band combination, can be seen from the results, with the decrease of the order of recognition rate showed a rising trend measured. On the one hand to verify our conclusions, on the other hand, also it shows that the impact of the order of the wavelet transform of the results.

**Table 1. Effect of the Sub-Bands on the Detection Rate**

| subband serial number | RGB | HSV |
|---|---|---|
| 1 | 65.58 | 70.69 |
| 2 | 60.11 | 65.04 |
| 3 | 69.31 | 63.63 |
| 4 | 69.18 | 70.19 |
| 5 | 79.25 | 82.04 |
| 6 | 74.26 | 71.32 |
| 7 | 64.22 | 73.25 |
| 8 | 80.27 | 76.38 |
| 9 | 74.17 | 74.31 |
| 10 | 70.13 | 68.52 |
| 11 | 74.96 | 64.04 |
| 12 | 72.36 | 73.13 |
| 13 | 71.01 | 72.09 |

## Conclusion

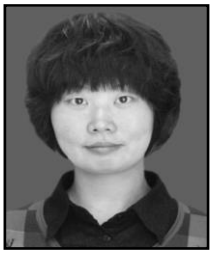
Digital image in our daily life are widely used, so that we increasingly rely on digital images of the media for more information. Digital image authenticity certification has become a very important research topic. This article is in the passive frame digital image forensics forensics technology deployment, focusing on the image of the scene authenticity certification, which is natural images and computer-generated image detection classification. Computer-based image defect in the edge of the construction aspect, the paper starting from the edge of the image, with high-end features to describe wavelet edge difference image, combined with high-end features prediction error image wavelet transform is proposed based on computer image detection algorithm edge detection.

## References

[1] C. Tang, P. Hinsinger and B. Jaillard, “Protected article Effect of phosphorus deficiency on the growth, symbiotic N 2 fixation and proton release by two bean (Phaseolus vulgaris) genotypes”, [J]. image, vol. 23, no. 25, **(2015)**.
[2] C. B. Claiborne and M. J. Sirgy, “Self-image congruence as a model of consumer attitude formation and behavior: A conceptual review and guide for future research”, Proceedings of the 1990 Academy of Marketing Science (AMS) Annual Conference, Springer International Publishing, **(2015)**, pp. 1-7.
[3] H. Yang, L. Shao and F. Zheng, “Recent advances and trends in visual tracking: A review”, [J]. Neurocomputing, vol. 74, no. 18, **(2011)**, pp. 3823-3831.
[4] S. Zhang, H. Yao and X. Sun, “Sparse coding based visual tracking: Review and experimental comparison”, [J]. Pattern Recognition, vol. 46, no. 7, **(2013)**, pp.1772-1788.
[5] C. Chang and R. Ansari, “Kernel particle filter for visual tracking”, [J]. Signal processing letters, IEEE, , vol. 12, no. 3, **(2005)**, pp.242-245.
[6] H. Grabner and H. Bischof, “On-line boosting and vision”, [C]. Computer Vision and Pattern Recognition, 2006 IEEE Computer Society Conference on. IEEE, vol.1, **(2006)**, pp.260-267.
[7] H. Grabner, C. Leistner and H. Bischof, “Semi-supervised on-line boosting for robust tracking”, [M]. Computer Vision–ECCV 2008. Springer Berlin Heidelberg, **(2008)**, pp. 234-247.
[8] S. Stalder, H. Grabner and L. V. Gool, “Beyond semi-supervised tracking: Tracking should be as simple as detection, but not simpler than recognition”, [C]. Computer Vision Workshops (ICCV Workshops), 2009 IEEE 12th International Conference on. IEEE, **(2009)**, pp. 1409-1416.

[9] B. Babenko, M. H. Yang and S. Belongie, "Visual tracking with online multiple instance learning", [C]. Computer Vision and Pattern Recognition, CVPR 2009. IEEE Conference on. IEEE, **(2009)**, pp. 983-990.
[10] N. Dalai and B. Triggs, "Histograms of oriented gradients for human detection", [C].Computer Vision and Pattern Recognition, 2005. CVPR 2005. IEEE Computer Society Conference on. IEEE, , vol. 1, **(2005)**, pp. 886-893.
[11] N. Dalai, B. Triggs and C. Schmid, "Human detection using oriented histograms of flow and appearance", [M], Computer Vision-ECCV 2006. Springer Berlin Heidelberg, **(2006)**, pp.428-441.
[12] Y. Xiang and G. Su, "Multi-parts and multi-feature fusion in face verification", [C].Computer Vision and Pattern Recognition Workshops, 2008. CVPRW 08. IEEE Computer Society Conference on IEEE, **(2008)**, pp. 1-6.
[13] J. Chen, Y. He and J. Wang, "Multi-feature fusion based fast video flame detection", [J]. Building and Environment, vol. 45, no. 5, **(2010)**, pp.1113-1122.
[14] J.-H. Tu and Z. Quan, "Design and implementation od the crying voice detection circuit in the baby's supervision system", [J]. Review of Computer Engineering Studies,vol. 1, no.1, **(2014)**, pp.13-16.
[15] W. Ya and S. Qin, "Aircraft fault diagnosis by solving map exactly", [J]. Review of Computer Engineering Studies, vol. 2, no. 1, **(2015)**, pp.1-8.

## Authors



**Yan Wang**, She received her bachelor's degree in Fine Arts from Henan University, Kaifeng, China, in 2002, the master degree in Fine Arts from Henan Normal University, Xinxiang, China, in 2012. She is now a lecturer at Center of Modern Education Technology in Xinxiang Medical University. Her current research interests include computer application technology, modern education technology, medical image processing, computer-assisted two-and-three dimensional animation.

**Xiao Wang**, She received her bachelor's degree in computer application from Henan normal university, Xinxiang, China, in 2002, a master's degree in computer from Henan University, Kaifeng, China, 2010. She is now an experimentalist in Xinxiang medical university computer center. Her current research interests include computer application technology, and medical image processing, computer assisted gravity d animation.