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Research Article

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The design of panda-oriented intelligent recognition system

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ABSTRACT

China is a country distributed with a large number of endangered animals. However, the monitoring and protection of wildlife is not very good. To carry out wildlife image recognition technology research is of great significance in the conservation of wildlife diversity. In this paper, the giant panda is chose as the research object, and a rare wildlife intelligent recognition method is designed based on BP neural network. Compare with previous work, the system is more intelligent and it can save resources and raise working efficiency. To verify the proposed methods, a processed image is given .This paper introduces the system's hardware configuration, the giant panda image feature extraction methods, the implementation of BP neural network, and summarizes the advantages and disadvantages of the system in the end.

Keywords*:* panda, feature, extraction, BP neural network.

INTRODUCTION

Panda known as the "living fossil" and the "Chinese national treasure" has been living on earth for at least 8 million years. It is the ambassador of WWF and the world's biodiversity conservation flagship species. According to the third national giant panda population survey, there are less than 1,600 wild pandas surviving around the world. Since the State Planning Commission approved the launch of a 10-year project called the" China Giant Panda Protection and Its Habitat Project" officially in 1992, many places have carried out a lot of work in local resource surveys, infrastructure construction, personnel integrated capacity-building, publicity and education, panda resources conservation and monitoring, artificial breeding research and made some progress [1]. However, the giant panda protection situation is still not optimistic. This paper designs a kind of intelligent recognition method for giant panda image which provides technical supports for real-time monitoring and the protection of the giant panda.

OVERALL SYSTEM DESIGN

This paper designed a kind of intelligent recognition method for giant panda image. When the infrared trigger camera detects an animal invasion, the camera takes photos automatically and the system extracts feature from the taken photos. Then, the pattern recognition will be done based on the extracted feature values .Finally, those pictures whose recognition result is giant panda will be sent to the Monitoring center through the 3G wireless sensor networks. The overall system block diagram is shown in Fig.1

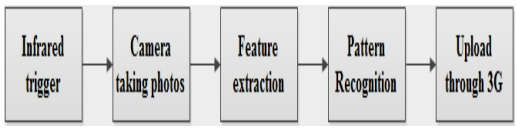

Fig. 1 Overall system block diagram

HARDWARE DESIGN

System uses 1/4 inch CMOS cameras to take pictures. Compared with the CCD camera, CMOS camera has a relatively simple structure and has the same manufacturing process with the existing large scale integrated circuit. The production cost can be reduced due to its strong integration. In principle, CMOS signal is the signal point of the charge unit, while the unit of the CCD is a current signal, the former is more sensitive, faster and more power. The image processing chip in this system is TVP5146. The advantage of this chip is that the field sync signal VS, the horizontal sync signal HS, odd field signal FID and the clock output signal PCLK are all led by the pin directly, eliminating the need for synchronizing the clock circuit [2]. In addition, the system's hardware design also includes 3G wireless module MW100-X2Q7a, microprocessor chip S5PV210, Ethernet controller chip DM9000, SDRAM, etc. S5PV210 has low power consumption, streamlined and excellent fully static design features. With its MMU memory management functions and an independent 512 KB instruction and data caches, it provide a reliable performance in high-performance and low power consumption. The system hardware structure is shown in Fig.2.

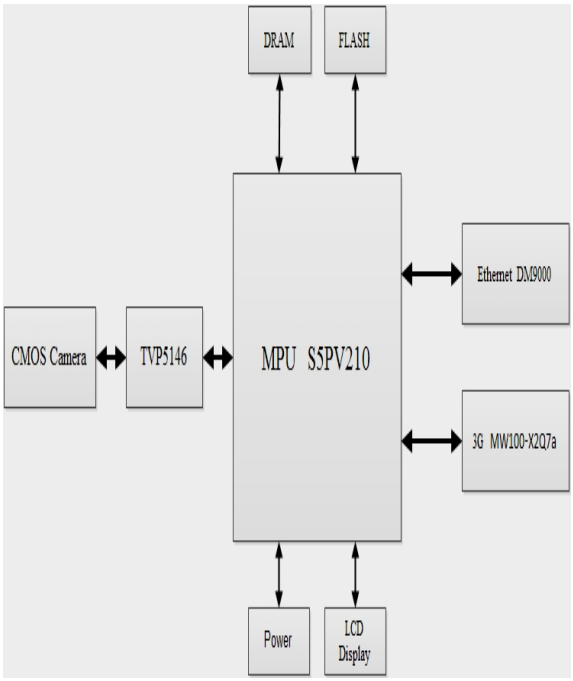

Fig. 2 System hardware structure

ALGORITHM PLATFORM BUILDING

The algorithm is based on the Android platform. Android is a mobile operating system based on Linux kernel which is announced by Google in 2007 and currently developed by the Open Handset Alliance. The system is divided into a total of three layers which are developed by different development languages and environments. The bottom is developed by the C language, the middle layer is composed of a number of C + + development libraries and a virtual machine used to debug and the top is the application developed by each enterprise or personal in Java language. Android platform has strong advantages. Firstly, it has openness: The platform allows any mobile terminal manufacturers to join the Android alliance; Secondly, it has Strong compatibility: It is without operator constraints and has a wealth of hardware support; Thirdly, it has strong Portability: the development environment is open and free. What's more, the simulation of algorithm is run in Matlab after which mainstream C language is used to realize the function, while, Android can just directly call C program .This will not only save costs by Android (compared to the general DSP and FPGA), but also enjoy 3G high speed transmission. You can use the C language to write code for the mainstream and it has a very high practical value. The technology roadmap of identification system algorithm is shown in Fig.3.

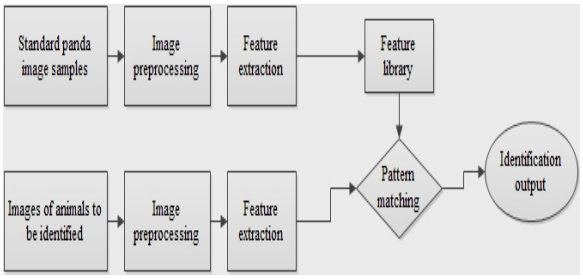

Fig. 3 Technology roadmap of identification system algorithm

FEATURE EXTRACTION METHODS

Feature extraction is a concept of computer vision and image processing. It refers to extract image information using a computer to determine whether each image point belongs to an image feature. Feature extraction' result is to divide a point on the image into different subsets .These subsets are often belonging to isolated point, a continuous curve, or a continuous area. What we usually refer to as feature extraction is based on image content .The characteristics of image content include the image appearance characteristics (color, texture, shape) and semantics [3], in which the image of the appearance characteristics are considered as characteristic of the lower level that has relatively intuitive feature. While, the semantics is the feature on a higher level which has a relatively subjective abstract feature. In terms of the development level of current computer and image understanding, expression completely based on the semantic features can't be achieved. While image characteristics such as color, texture, shape, spatial relations and feature does not need special knowledge and context information about the field and are widely used to extract features [4].

Feature extraction is directly related to the level of recognition efficiency of pattern recognition. Therefore reasonably select the target feature and extract method is very important. This article's research object is the giant panda and the color information is the most reasonable feature to identify this kind of animal. Considering the pure color features for image information expression ability is insufficient, the system introduces texture feature to be an assisted expression, Experimental results show that the combination of a variety of image features reasonably can be more accurate and comprehensive in description of the image content features.

COLOR FEATURE EXTRACTION

Color which is one of the basic characteristics of the image is widely used. The color histogram is usually used to describe color characteristics, which is directly obtained by statistical calculations based on the image or the entire image area of the pixel gray values or color values. It reflects the global feature of image color, depends little on its scale, direction and angle of view and it is of high stability. In general , other different color characteristics can be derived based on the color histogram, Such as the color mean, variance, energy, entropy, and color moment (1 ~ 3 order of three central moment), etc [5].

The color of pandas are mainly black and white, therefore using the histogram method can obtain very good results. The construction of its histogram can be summarized as the following two stages: First, determine the color histogram set; then quantify the target panda image' color set by mapping table; finally, obtain the color histogram by statistical method [6]. Figure 4 is a giant image and the corresponding target color histogram.

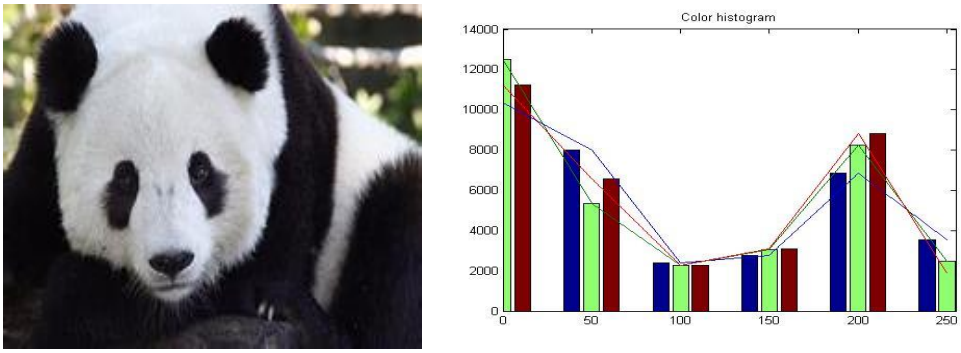

Fig.4 Color histogram of the target image

In this design, 3 central moments of the H component in the HIS space are selected to describe the color characteristics of the image. If the j-th pixel value of the i-th color component P_{ij}, the number of pixels of the image is N, then the three central moments of the i-th color component are:
The first central moment：

$$e_i = \frac{1}{N}\sum_{j=1}^{N} p_{ij} \quad (1)$$

The second central moment：

$$\sigma_i = \left(\frac{1}{N}\sum_{j=1}^{N}\left(p_{ij} - e_i\right)^2\right)^{\frac{1}{2}} \quad (2)$$

The third central moment：

$$s_i = \left(\frac{1}{N}\sum_{j=1}^{N}\left(p_{ij} - e_i\right)^3\right)^{\frac{1}{3}} \quad (3)$$

Convert the above RGB image to a HIS space, we can get the three central moments of the H component are 0.3630, 0.3197, 0.2360.

TEXTURE FEATURE EXTRACTION

For many images, the gray level distribution of a large area is cyclical or structural on the macro. This gray level distribution regularity on the macro called the image texture. Different animal species have different texture characteristics, and the texture characteristics are inherited. Thus using the texture feature to identify animals is also a kind of very effective method.

Statistical methods that are commonly used to describe texture are the gray level co-occurrence matrix, the gray stroke length method and the texture spectrum method; Method used to describe the structure texture is texture primitive parameters method and the spectrum methods are including the wavelet transform and the Cabor filter function. In this paper, gray differential statistics is used to extract texture features of giant pandas. For a given image f (i, j), calculate the gray-level histogram of image in which the difference has been normalized and a relatively flat histogram indicates the fine texture. The RGB color image is changed into gray image in this paper and the target image normalized histogram is shown in Figure 5.

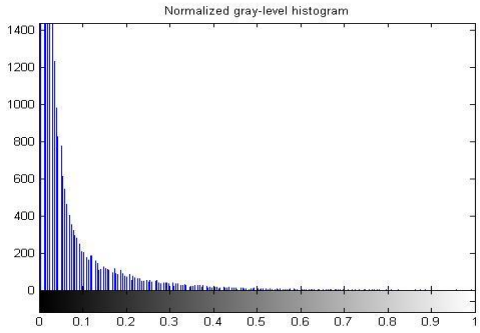

Fig.5 Normalized gray-level histogram

The following parameters are used to characterize the distribution of the histogram to reflect the level of fine texture.
Mean:

$$A_1 = \frac{1}{m}\sum_i i h_g(i) \quad (4)$$

Energy (Contrast)

$$A_2 = \sum_i \left[h_g(i)\right]^2 \quad (5)$$

Entropy

$$A_3 = -\sum_i h_g(i) \lg h_g(i) \quad (6)$$

The target image texture features calculated by the above formula are: mean =0.0527, con=623.7535, ent =4.6103.

CONSTRUCTION OF BP NEURAL NETWORK

Pattern classification is the main content of pattern recognition. Classic methods include Bayesian classifier, Fisher criterion and the nearest neighbor method and modern methods include fuzzy pattern recognition, artificial neural network pattern recognition, support vector machines and kernel-based classification method, etc [7]. Artificial neural network which is based on the understanding of human brain neural network is a network system constructed to implement certain functions. It has simplified, abstracted and simulated the human brain and it is the mathematical models of brain biological structures. What's more, it has a high degree of parallelism, highly nonlinear global role, excellent fault tolerance and associative memory function, very strong adaptive and self-learning ability, etc [8].

This design constructs a BP neural network for pattern classification. A BP artificial neural network is composed of 3 layers: input layer, hidden layer and output layer. Its core is to transmit error backward to adjust the network parameters (weights and thresholds) constantly so as to achieve or approximate the desired mappings between input and output. Lippmann [9] once pointed out a two- hidden- layer BP network can solve any kind of problem. So a three-layer BP network which contains one hidden layer is used in this paper. The network structure is shown in Figure 6.

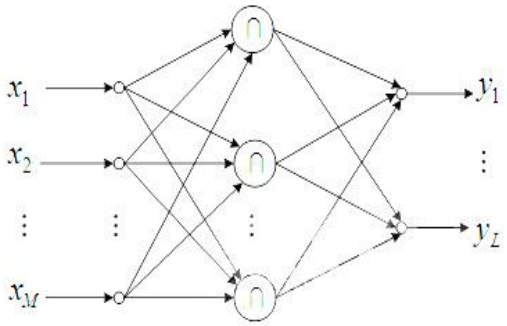

Fig.6 BP neural network structure

X is the input layer in the figure, Y is the output layer and the hidden layer is in the middle. In this design, the inputs are six data calculated through the feature extraction of color feature and texture feature parameters. Therefore, the input vector should be six-dimensional vector and the input layer nodes are 6. As the hidden layer nodes of the BP network have great influence on the performance and there is still no ideal analytic neurons can determine a reasonable number of nodes, the empirical formula can be used to calculate: $M = \log_2 n$, n is the number of neurons in the input layer. Finally, the hidden layer node number is determined 3.The output is a result of discrimination, so the use of one-dimensional output can meet the requirements. In other words, the number of neurons in the output layer is 1. The design of transfer function is typical, hidden layer uses the Sigmoid function while the output layer uses a linear function. Network with supervised learning approach to training uses the gradient descent method [10] to achieve the accuracy requirement of the network. As the BP network adopts an iterative update method to determine weights, so an initial value needs to be determined. The empirical value is between -2.4 / F and 2.4 / F, F is the number of the input neurons connecting weights. So select 0.1 as the input layer to the hidden layer weights initial value and 1 as the hidden layer to the output layer weights initial value. After determining the above parameters, normalize the training data and input them in the network for training and to get the desired neural network. The BP network flow chart is shown in Figure 7.

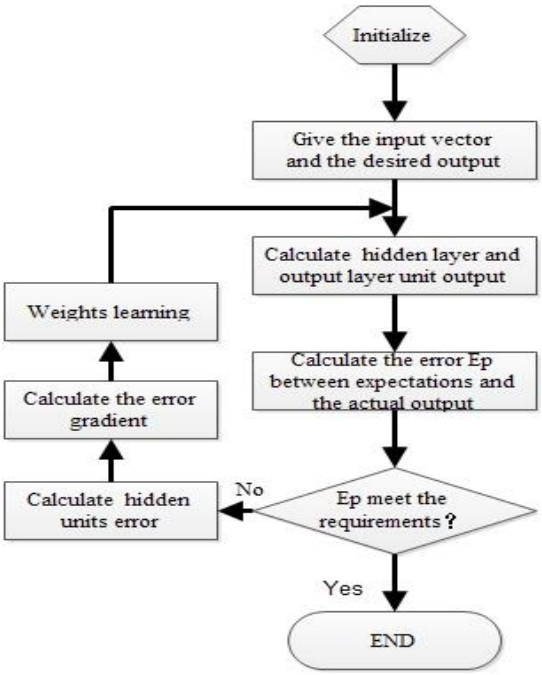

Fig.7 BP neural network flow chart

CONCLUSION

With economic development and environmental damage, more and more wild animals are endangered. Protecting endangered species has become an important responsibility for human beings. This paper presents a method for the identification of giant pandas. When animals are detected, the camera would take photos automatically and then the system will identify whether the photo is giant panda intelligently. If the answer is yes, the picture will be uploaded to the monitoring center otherwise the image will be deleted. This will save resources, improve work efficiency, achieve a more effective monitoring of and protection of the giant panda. The system will be further improved. By the research of new feature extraction methods, changing the objective function, modifying the policy function, improving training strategies and other methods to improve the speed and efficiency of the recognition system working.

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