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Study on TSCC image transmission system

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Abstract

Aiming at the problem of large capacity, bad channel conditions and interference in the image transmission system, the image transmission system based on the tandem source-channel is studied in this paper, which can effectively transmit the information. The image transmission system simulation model is built using the MATLAB simulation platform. The experimental results show that the TSCC image transmission system can effectively reduce the number of media needed to store, improve the transmission rate of information, and meet the needs of people for information transmission.

Keywords: tandem source-channel, image transmission system, wavelet transform, entropy coding

1. Introduction

With the rapid development of science and technology, people's demand for multimedia communications is also increasing. The related technology has become a research hotspot in the field of communication. Image communication as a fundamental part of the multimedia communication, has also been widely used. In order to reduce the transmission time, improve the transmission rate and reduce the transmission cost, we need to use image compression processing . In many practical communication systems, it has very important theoretical and practical significance to study how to use the tandem source-channel for image compression and transmission [1-3].

Image transmission is mainly to solve the problem of data compression. Data compression refers to the source signal with the least code, and reduce the signal space to accommodate the given information set or data sampling set. Image encoding and compression is applied to image data transformation and combination according to certain rules, so as to achieve as little as possible to code the information as much as possible [4-6].

At present, there are some problems in image transmission system:

(1) image capacity. Such as medical images, remote sensing images, etc.. These images often have the characteristics of high resolution, high precision, and large amount of data, which has brought great difficulties the storage and transmission.

(2) channel conditions are poor. For image transmission, the bit error rate is greatly increased due to fading phenomenon. The quality of the received signal is seriously deteriorated, and the reliability of image transmission is affected.

(3) the existence of interference. A large number of radio frequency devices and communications equipment has become the actual interference source , and even some home appliances, telephone, microwave ovens, etc., are likely the interfere sources. The interference signals emitted by the interference sources are sufficient to affect the input of the receiver, which leads to the receiver cannot receive the transmitted signal correctly, and the quality of the restored image is poor.

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In view of the above problems, we mainly study on image transmission system based on the tandem source channel in this paper, so as to reduce information storage medium number, improve the information transmission rate, reduce the transmission time and reduce the cost, continue to meet the demand of the information transmission.

2. Design of image compression coding transmission system based on TSCC

2.1 The steps of image compression coding transmission

The purpose of Image compression is to find high compression ratio and to make the compressed images to have an appropriate signal to noise ratio. The compression, transmission and recovery process also requires that the image distortion degree is small. The wavelet analysis is introduced into the image compression. When an image is decomposed by wavelet, a series of sub images with different resolutions can be obtained. The frequency of different resolution sub images is not the same. The values of most points of high resolution sub image are close to 0, the higher the more obvious. And for an image, the most important part of the performance of an image is the low frequency part. And wavelet analysis can make the compression ratio is high, the compression speed is fast, and the characteristic of the signal and the image can be kept basically unchanged after compression [7].

The steps of image compression encoding and transfer are as follows:

First, the image is made three-level wavelet decomposed using the 9/7 biorthogonal wavelet in tandem source channel image transmission system. Ten subband images are get by wavelet transform. The subband images represent the original image with different resolution of the original image, which contains the structure and detail information of the original image and ten subband image are independent to each other. The waveletcdf9/7 function is used in this paper.

Figure.1 shows the distribution of the ten sub bands. Then the resulted subband images are quantized. we use non-uniform quantization in this process. The ten sub band images containing different details, so different sub band images quantitative are distributed different number of bits. The first sub band is assigned to a 7 bit; the 2,3,4 sub band is assigned to a 5 bit; the 5,6,7 sub band is assigned to a 3 bit; the 8,9,10 sub band is assigned to a 1 bit. Using Lloyds and Quantiz functions, the output index value of the ten sub band images are from ind1 to ind10.

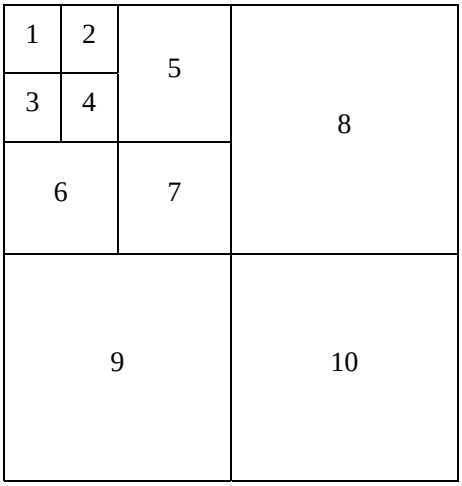

Fig. 1. Distribution of wavelet sub bands

The results of the quantized output are coded respectively by Huffman coding [8-11].The image of Huffman coding is realized by norm2huff function in the experiment. Different codewords are given to each gray levels according to the different frequencies of each sub band quantized output appears in the image gray level. The characters with high frequency are given short code word, and the characters with low frequency are given long code word. The data compression is implemented effectively. The next step is to binary BCH code for Huffman coding results, the transmission reliability is ensured by adding certain supervisory symbols to the code[12-13]. After the transmission of a binary symmetric channel, Huffman decoding is implemented to the results of coding. The huff2norm function is used in Huffman image compression decoding procedure. The reconstructed image can be obtained by the inverse quantization and the inverse wavelet transform.

2.2 The framework of TSCC system

TSCC transmission system is shown in Figure 2.

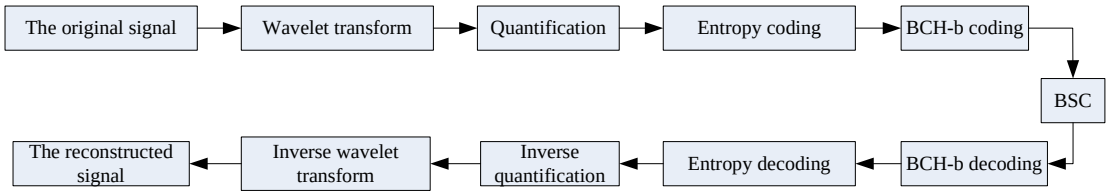

Fig. 2. TSCC image transmission system

Firstly, the image is divided into ten sub bands compression images after wavelet transform. In the process of digital image quantification, ten different sub-bands obtained by wavelet transform are allocated different numbers of bits to quantize. The large probability is given a bit of a few, and the small probability is given a bit of a more. The sample values of the same level are classified as a category, and given a quantitative value. The more the quantitative order, the quantization error is smaller, the better the quality. Entropy encoding is to code the results using Huffman coding. The source relevance is solved using the source statistics. The transmission efficiency of the system is improved, which ensure the stable transmission of image data transmission when a large number of data are transmitted. In order to overcome the noise and interference in the channel and to avoid transmission error ,check code is added to the transmitted information symbols. At the receiver, check code and information symbols are used between the supervision rules to detect and correct the mistakes. Then through the physical channel, the channel model is used to simulate the binary symmetric channel. Binary symmetric channel is discrete memoryless channel, its input and output are only 0 and 1 symbols . The probability of sending 0 and receiving up to 1 and sending 1 and receiving up to 0 is the same. So called channel is symmetric. Then the original image is reconstructed by the inverse transform, and the original image is compared with the reconstructed image to obtain the distortion.

2.3 The evaluation of image transmission quality

In this paper, we use Power Signal-to-Noise Ratio (PSNR)and Mean square error (MSE)to evaluate the performance of the system. MSE is a distortion measure between the original image and the reconstructed image, which is defined as formula(1):

$$MSE = \frac{\sum_{n=1}^{Framesize}\left(I^n - P^n\right)}{Framesize} \tag{1}$$

MSE is the mean square error between the original image and the processing image. It is the average number of different data from the average distance. I^n refers to the n pixel value of the original image and P^n refers to the n pixel value of the processed images . The unit of PSNR is dB. So the greater the value, the less the distortion of the image. The expression of peak signal to noise ratio and mean square error are:

$$PSNR = 10 * \log_{10}\left(\frac{255^2}{MSE}\right) \tag{2}$$

3. Experiment and Results Analysis

The image with 256 grayscale is as the original signal of TSCC image transmission system. The original image completed the TSCC image transmission system by wavelet transform, quantization, Huffman coding, binary BCH code, binary symmetric channel, binary BCH coding, Huffman coding, inverse quantization, inverse wavelet transform and image reconstruction.

Fig.3. The original image

Fig.4. The reconstructed image

The experimental results can be obtained by MATLAB simulation. The original image and the reconstructed image are shown in Figure 3 and Figure 4. The reconstructed image and the original image is not obvious difference. The PSNR value is 38.4799 and the MSE value is 9.2276. It can be concluded that the TSCC image transmission system can achieve the image data compression and transmission on the premise of ensuring the image quality.

3. Conclusions

TSCC image transmission system was realized in this paper, which is a classical image transmission system. It effectively solves the problem of processing, storing and transmitting a large amount of image information. TSCC image transmission system consists of two main steps: image compression and data transmission. TSCC image transmission system can compress and transmit the image data effectively under the precondition of ensuring the quality of the image. In short, TSCC image transmission system is

an effective image transmission system .

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