Research on the Application of Artificial Intelligence Technology in Computer Graphics Processing

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Abstract. In structured light geometric reconstruction, due to the complexity of shooting methods and scene lighting conditions, the resulting images may be lack of image details due to uneven light. For this reason, the article proposes a Retinex algorithm with colour restoration and colour saturation correction strategy based on HSV colour space transformation based on artificial intelligence technology. Then distinguish whether it is a bright area according to the threshold value, and modify the insufficient transmittance estimation of the bright area. Finally, the intensity component and saturation value are restored in the HIS colour space, and the histogram is used to stretch the intensity component.

Keywords: Artificial intelligence, HSV colour space, image processing, computer, image enhancement.

1. Introduction

As a basic method for humans to understand and express the world, images are widely used. From ancient murals and hieroglyphs to today's digital video, images have been accompanied by the development of human history. People also expect to get intuitive information from images, "Seeing "Being believable" is a natural thing. However, with the expansion and popularization of information, things are not so simple.

With the rapid development of multimedia technology and the relaxation of network bandwidth restrictions, more and more digital images are transmitted on the Internet. Some of this image information are irrelevant, and some are vital [1]. They may involve personal privacy and company's privacy. The value of interests and national security cannot be measured. On the other hand, the popularity of the Internet makes it possible for anyone to access the information in it and collect it, regardless of whether the collection is benign or malicious, legal, or illegal. This The security of images transmitted on the network has attracted much attention, and the encryption of images has become an important research direction. This paper proposes a Retinex algorithm with colour restoration and an image colour saturation correction method based on HSV colour space conversion. The algorithm is applied to the structured light image enhancement processing, so that the structured light image can be enhanced while the colour is maintained.
2. Theoretical knowledge

2.1. RGB colour space
The RGB colour space is the most used colour space. The image displayed by a computer monitor is represented by the RGB colour space. RGB is derived from the human vision's approximate measurement of the spectral quantization properties of the three primary colours, namely red, green, and blue [2]. Therefore, it is a natural format to use the three components of R, G, and B to characterize colours. And because most of the current image acquisition equipment is based on CCD technology, it directly perceives the three components of colour R, G, and B. The superposition of the three components can produce various colours, which also makes the RGB model become imaging, display, and printing. The RGB colour model plays a very important role in social life.

2.2. HSV colour space
The HSV colour space not only describes the colour but also the component occupied by the colour. The colour space uses the chromaticity H to describe the colour information. Separate the brightness information. To achieve the purpose of ignoring the brightness information. The HSV colour system model not only directly reflects the way humans observe colours, but also facilitates image processing. In the use of colour information, the advantage of this model is that it separates the brightness and the two parameters that reflect the nature of colour, chroma H and colour saturation S. When extracting the colour characteristics of a human face, it is often necessary to understand its clustering characteristics in a certain colour space. In fact, the colour clustering characteristics are often reflected in the essential characteristics of colours, namely chroma and colour saturation [3]. The impact of light intensity on the image is mostly reflected in the impact on the brightness component V. Therefore, if the brightness information can be separated from the colour, and only the chroma and colour saturation that can reflect the nature of the colour are used to implement the cluster analysis, a good effect will be achieved. This is also the reason why HSV space is widely used in colour image processing and computer vision.

2.3. YCrCb colour space
The YCrCb colour space is derived from the YUV colour space through modification coefficients and deviations. Different YCrCb standards have been formulated internationally according to different industry standards. Usually, RGB images are converted to YCbCr colour space for image processing. Where Y refers to the brightness, and Cr and Cb together represent the chrominance information of the colour, Cr represents the difference between the red component and the brightness, Cb represents the difference between the blue component and the brightness, and Cb and Cr are relatively independent. It is obtained by slightly adjusting the weights of U and V respectively. The YCbCr colour space, which is digitally equivalent to the YUV colour space, is a colour model adopted in the CCIR601 coding scheme targeting studio quality standards, and is widely used in television colour display and other fields.

3. Sparse image colour model and its representation on YCrCb colour space
This paper has proved through a lot of experiments that the traditional RGB to YCrCb algorithm obtains the Cr and Cb values to show certain regularity. When the light intensity Y changes in [60, 200], the Cr and Cb values change very little with the light intensity Y. The clustering is strong, showing strong stability. When the light intensity value Y exceeds 200, the Cr value gradually decreases until it approaches zero, while the Cb gradually increases until it approaches zero. This phenomenon is caused by the inherent properties of the YCrCb colour space. When Y increases toward 255, the image is close to white [4]. Currently, the pixel RGB value is Oxfffff, that is, R, G, B tends to 255. That is, the values of R and Y, the closer the values of B and Y are, and the values of Cr and Cb are exactly the difference between the red component, the blue component, and the brightness, so the values of Cr and Cb also approach 0. In order to verify the above theory experimentally, the
SONY T-90 camera is used as the image acquisition device to adjust the camera's exposure gradually from small to large in 12 times.

Considering that the distribution of image colours in the YCrCb colour space has similar clustering characteristics, and the correlation between the 3-channel information is low, it can be considered to establish a sparse model and assume that the Y, Cb, and Cr 3-channels are independent of each other. On each channel, a conditional probability model is established between pixel values, which means that when the c0 value on this channel is the image colour component, the c1 value is also the conditional probability of the image colour component, that is

$$p(c_1 | c_0) = \frac{1}{(2\pi)^{1/2}} \exp\left[-\frac{(c_1 - c_0)^2}{2\sigma_0^2}\right]$$

(1)

The pixel-level conditional probability model under the independence assumption can be written as

$$p(c_1 | c_0) = \prod_{i=1}^3 \frac{1}{2\pi \sigma_i^{1/2}} \exp\left[-\frac{(c_{1i} - c_{0i})^2}{2\sigma_i^2}\right]$$

(2)

In the formula, c represents the corresponding YCrCb 3 channel values.

It can be seen from equation (2) that the approximate image colour pixel range in YCrCb colour space [16,235] [16,240] requires a huge amount of calculation to learn the above model. In order to reduce the amount of calculation corresponding to the model, the colour space needs to be sparsely expressed, the Y channel is expressed as 55 discrete intervals, and the Cr and Cb channels are simultaneously expressed as 25 discrete intervals. The conditional probability that an unknown pixel belongs to the image colour space Sc represents a dependent information form.

$$p(c_i \in S_c) \propto \prod_{\text{Index}(c_j) \neq \text{Index}(c_i)} p(\text{Index}(c_i) | \text{Index}(c_j)) =$$

$$\prod_{\text{Index}(c_j) \neq \text{Index}(c_i)} \left( \frac{1}{2\pi \sigma_i^{1/2}} \exp\left[-\frac{(c_{\text{Index}(c_j)i} - c_{\text{Index}(c_i)i})^2}{2\sigma_{\text{Index}(c_j),\text{Index}(c_i)}^2}\right] \right)$$

(3)

According to formula (3), the most important information about the associated probability of the pixel interval is the probability information between each pixel interval and its neighbouring interval. The information between the non-neighbouring intervals is relatively weak, so it can be appropriately ignored. Approximate, so the focus of computational learning is placed around the neighbourhood.

4. Offline training and result analysis of image colour and non-image colour neighbourhood space model

Using training images taken from a fixed experimental scene, the image colour neighbourhood space model and the non-image colour neighbourhood space model are trained separately [5]. The initialization of the model training uses the training results of the RGB non-correlation model in. In order to learn the image colour model further accurately, the colour space model is trained under the assumption of the RGB 3-channel correlation, which can more effectively describe the three channels. Relevance between.

Convergence detection is performed on the log-likelihood value of the model through the training data, and the convergence condition is that the increment of the log-likelihood value of the data is less than 0.01. Use image colour positive samples (total 3793×742 pixels) to train the image colour model,
non-image colour negative samples (total 4421×880 pixels) to train the non-image colour model, the convergence monitoring results are shown in Figure 1, the training is 40 It tends to converge after a step.

![Figure 1. Color space model EM algorithm log-likelihood curve](image1)

The probability density distribution of the image color model and the non-image color model on the two cross-sections of the RGB color space when the 50-step training converges is shown in Figure 2 and Figure 3. As the iteration tends to converge, the distribution of probability density from the beginning has the characteristics of a certain aggregation distribution, to the distribution between multiple label categories tends to be balanced, indicating that the consistency between the model parameters and the training data has been greatly improved. In the model after initialization and iterative learning 50 times, the receiver operating characteristic curve (ROC) of several appropriate thresholds corresponding to the test image in the same working scene is shown in Figure 4. It can be seen from Figure 4 that the appropriate segmentation threshold corresponding to the learned model and the distribution used for initialization is significantly different in order of magnitude, indicating that the clustering features are gradually enhanced [6]. When the false positive class is low, the true class probability value of the initial model result is significantly higher after 50-step iterative learning, indicating that the converged model result has a significant increase in the recognition ability of the test image under hard threshold segmentation.

![Figure 2. The edge distribution of the EM algorithm learning results of the image color space model](image2)
Figure 3. The edge distribution of the learning results of the non-image color color space model EM algorithm

Figure 4. ROC curve of test picture of image color space model learning results

Figure 5 shows the enhancement processing of the crowd image under night illumination. In Figure 5a, due to insufficient lighting conditions, the black man on the far left is almost submerged in the background, making it difficult to recognize; in Figure 5b, although the overall effect is white and the color is distorted, but the details of the dark part have been clearly restored, and the black on the left is clearly visible; compared with Figure 5b, in addition to the details of the dark part, the color of the character’s skin and hair is closer to the original image in Figure 5c, and the color recovery ability Better than traditional MSRCR. Since the actual actual lighting conditions cannot be obtained only from the image I, the incident light E is estimated using the image I and the Gaussian kernel function, and there are singularities when RGB is converted into the HSV space, that is, when S=0 in equation (3), Therefore, the algorithm in this paper may cause some details to be lost. In engineering applications, local minute details are often regarded as noise filtered out, so it is acceptable in practical applications.

Figure 5. Portrait image enhancement result
5. Conclusion
In this paper, the dark primary colour value is corrected according to the relationship between the scene depth and the pixel colour depth in the RGB colour space, and the intensity component is restored in the HSI colour space, and the saturation is calculated. The experimental results show that the edge part of the image scene processed according to the algorithm in this paper will not produce the white fringe phenomenon overcomes the distortion problem in the white area, and the image is clear and faster.

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