Application of Machine Learning and Natural Language Processing Methods in Image Adaptive Processing

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Abstract: Image Adaptive Processing is a Key Part of Image Processing. Based on the Rapid Development of Information Technology Such as the Internet, Technologies in the Field of Artificial Intelligence Such as Machine Learning and Natural Language Processing Technologies. They Play an Increasingly Important Role in Image Adaptive Processing and Have Attracted Widespread Attention. However, the Operation of Artificial Intelligence Technology Requires High Programming and Working Ability. This Paper Mainly Studies and Explains the Specific Application of These Two Technical Operation Methods and Related Precautions, and Provides Some Insights for the Application of Machine Learning and Natural Language Processing Methods in Image Adaptive Processing. At the Same Time, a Low Illumination Image Adaptive Enhancement Algorithm is Proposed.

1. Introduction

In the Process of Acquiring and Transmitting Information, the Amount of Information Contained in Digital Images is Much Higher Than the Amount of Information Contained in Other Ways Such as Text and Speech. Since the Digital Image Acquisition is Interfered by External Light Intensity, Natural Weather, Imaging Equipment and Noise, the Captured Image Brightness, Content Definition and Color Saturation Are Low in Quality, Which is Not Conducive to the Extraction of Image Content. Therefore, Digital Image Adaptive Processing Technology Came into Being[1-3].

Natural Language Processing and Machine Learning Are the New Generation of Technical Operation Methods for the Development of Computer Technology, and Are Very Important in the Category of Artificial Intelligence Technology. the Core of It is to Let the System Imitate Human Intelligence to Automatically Handle Various Tasks through Programming, Which Makes Image Adaptive Processing Begin to Move Toward Automation and Intelligence.

In Order to Overcome the Problems of Low Brightness and Low Quality of Low Illumination Images, Many Scholars Have Studied and Proposed a Series of Image Enhancement Algorithms in the Early Stage. among Them, Retinex, Homomorphic Filtering Histogram Equalization and Other Algorithms Are Common Image Enhancement Methods[4-7].

This Paper Proposes an Adaptive Local Spatial Homomorphic Filter Algorithm. the Algorithm Does Not Need to Constrain the Input Image Size, Not Only Can Improve the Image Brightness, But Also Eliminate the Edge Block Effect.

2. Image Adaptive Enhancement

Images play an important role in our daily life and scientific research, but many images with important information hinder their own value because of their quality problems. In order to capture the important content contained in the image, we need to perform image adaptation on low quality images. The purpose is to improve the quality of the image so that the value in the image is fully reflected (Fig.1).

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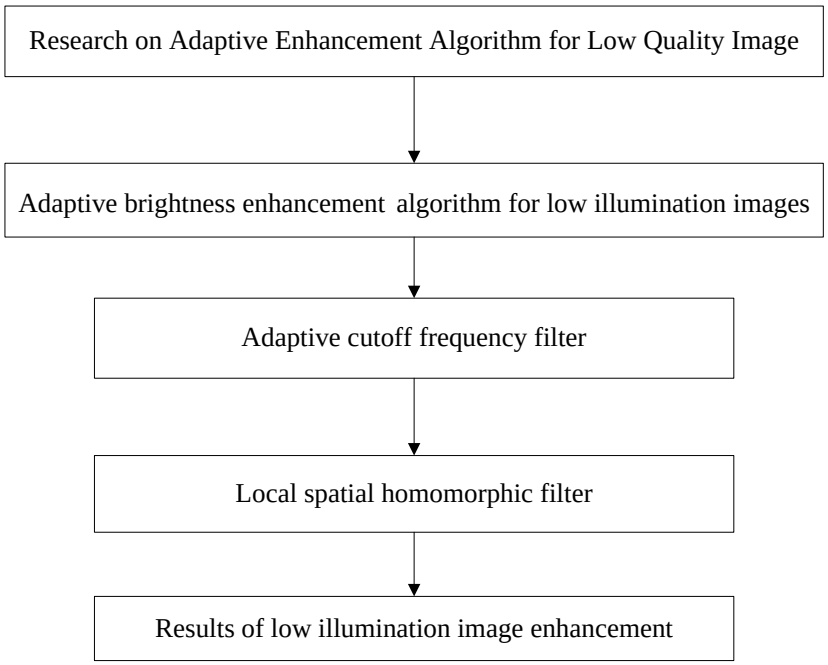

Fig.1 Low-Quality Image Adaptive Enhancement Algorithm Research Process

2.1 Low Illumination Image Adaptive Enhancement Technology

Low-quality image enhancement is a hot topic in the field of digital image processing research, especially in terms of traffic safety, medical imaging and video tracking. The images we get are usually not high-definition moving images, especially when the light intensity is low during the capture process, or the light intensity is very weak at night. In order to reduce the impact of low-quality images, we adopt image adaptive processing. The purpose is to improve the image illumination brightness and color saturation, and reduce the interference of external factors on the image content. The low illumination image enhancement algorithm is initially studied from the pixel points of the input image. The grayscale variation processing is the simplest spatial domain image processing method in the image enhancement algorithm.

The square straight graph equalization algorithm operates on the pixel gray value of the original image relative to the concentrated defect and the pixel value of the image to be processed. The principle of histogram equalization is to use a linear transformation method to extend the range of pixel values of the image to be processed to cover the entire gray level range. The gray value of the enhanced image pixel has a high dynamic range, so the pixel value of the transformed image has a significant contrast.

A.V.Oppenhei proposes a homomorphic filtering algorithm. The algorithm combines image grayscale variation and frequency domain filtering to process the input image. The principle is to enhance the image quality by enhancing pixel point value compression and image brightness enhancement. The adaptive local spatial homomorphic filtering algorithm adaptively filters the spectrum of the input image by optimizing the filtering function. Since the local spatial homomorphic filter is a single pixel shift, there is no constraint on the size of the input image. This improves the flexibility of the algorithm and avoids the edge blockiness of local homomorphic filters and spatial multi-scale homomorphic filter algorithms. The general illuminance reflection model combines the image to be processed $f(x,y)$into a combination of the incident component of the low frequency portion and the reflection component of the high frequency portion, as follows[7]:

$$f(x,y) = i(x,y) * r(x,y) \tag{1}$$

Where,$i(x,y)$ represents the incident portion of the image, which is a low frequency component in which the image intensity is slowly transformed. $r(x,y)$ represents the reflection component of the image, which is a high-frequency component whose pixel intensity transforms faster. When the homomorphic filtering algorithm operates on the low-illuminance image brightness enhancement, it

usually suppresses the low-frequency bandwidth of the image and expands the high-frequency bandwidth. Based on this idea, when dealing with low-light images, we need to perform frequency domain conversion on the original image. The steps of homomorphic filtering for low-illuminance image brightness enhancement processing are shown in the figure (Fig.2)

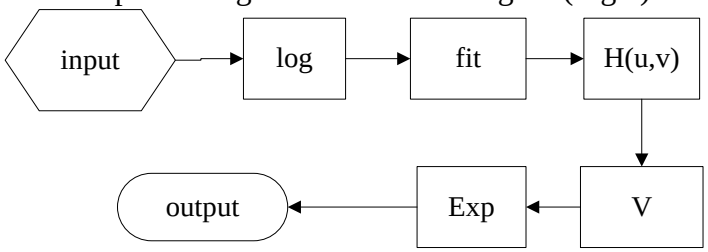

Fig.2 Homomorphic Filtering Principle Flow

2.2 Adaptive Local Spatial Homomorphic Filtering Technique

In the whole image filtering process, the role of the transfer function is particularly important, and different transfer functions will get different filtering results. There are low illumination images with high dynamic range, so when selecting the transfer function. I hope he can have different effects on the high frequency part and the low frequency part of the image. The homomorphic filtering system function relationship diagram is as follows(Fig.3).

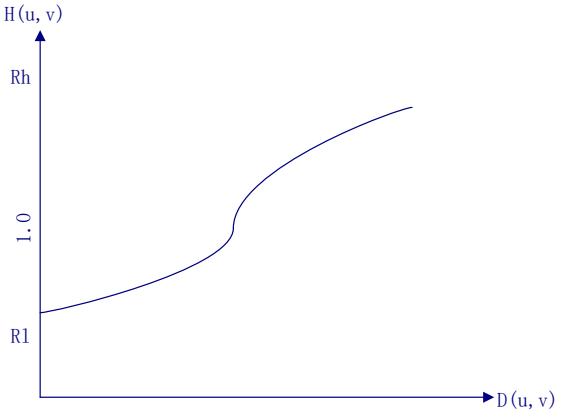

Fig.3 Homomorphic Filtering System Function Diagram

In the figure, Rh and Rl are the gain amplitudes of the high frequency and low frequency, respectively, H represents the transfer function of the homomorphic filter, and the distance D represents the Euler distance of the frequency in the image to the center position of the filter function. The trend of the function curve of the filter system in the figure is similar to the high-pass filter curve. In the digital image, the high-pass filter filters the lower portion of the image and leaves the higher frequency portion, thereby achieving an enhanced image. Common high pass filters include high pass filters, Butterworth filters and exponential filters. By substituting these high-pass filter functions into the transfer function of the homomorphic filter, we can obtain different types of homomorphic filters[8-10].

(1)Butterworth line filter

(2)The formula is a Butterworth type transfer function:

$$H(u,v)=\frac{1}{1+[\frac{D_0}{D(u,v)}]^2} \tag{2}$$

The transfer function is a homomorphic filter of Butterworth filtering:

$$H_a(u,v) = (R_H - R_L)\frac{1}{1+[\frac{D_0}{cD(u,v)}]^{2n}} + R_L \quad (3)$$

(3) Gaussian high-pass filter

(4)The formula is the transfer function of the Gaussian high-pass filter:

$$H(u,v) = 1 - e^{\frac{D^2(U,V)}{2D_0^2}} \quad (4)$$

The homomorphic filter expression for the high-pass filtering of the transfer function is as follows:

$$H_a(u,v) = (R_H - R_L)\{1 - e^{-C(\frac{D^2(U,V)}{2D_0^2})^{2n}}\} + R_L \quad (5)$$

(5)Exponential high pass filter

(6)The formula is the transfer function of the exponential high-pass filter:

$$H(u,v) = e^{-(\frac{D^2(U,V)}{2D_0^2})^2} \quad (6)$$

The transfer function is an exponential homomorphic filter:

$$H_a(u,v) = (R_H - R_L)e^{-C(\frac{D_0}{D(u,v)})^n}) + R_L \quad (7)$$

Where, D_0 represents the phase frequency, c is a constant, used to indicate the filter sharpening, the cutoff frequencyD_0 requires a large number of experimental results, n is generally selected 1.

3. Image Adaptive Processing in Natural Language

3.1 Basic Operating Principles

When performing image adaptive processing in natural language processing, the basic operating principle of this technique should be clarified. It is important to clarify the direction of technology optimization and establish a responsive structural system. Natural language is the language in which people communicate with each other everyday, such as English and Chinese. Natural language processing is a science that combines linguistics, computer science, mathematics, and physics. Natural language image adaptation is to process image processing in a familiar language habit, without the need for people to understand the language equations used in computer programming. This allows people in the traffic safety department, medical imaging doctors to operate computer equipment to complete image recognition and image enhancement processing. In the specific operation process, it also involves data conversion of image information and the like. In this way, it is convenient for the staff to use image adaptive processing technology.

3.2 Establishment of the Structural System

In the practical application of image adaptive processing, people also need to establish some structural systems to process the image processing process in the corresponding system structure. In the specific image adaptive processing, a parallel computing framework can be established to synchronize various images. Its synchronous computing framework also relies on natural processing techniques to complete the classification and recognition of images. The staff can set up the corresponding computer running program to perform judgment, classification and identification work by running a series of processing processes. This kind of natural language processing based on artificial intelligence technology can effectively reduce the programming pressure of the staff, but in the actual operation process, it may affect the efficiency of the work due to the computing power

of the computer. This requires computer technology to be further optimized, and the current optimization focus is on the learning of human intelligence in computer equipment.

4. Image Adaptive Processing under Machine Learning

Machine learning has become one of the important technical means of image adaptive processing intelligence. The focus of related research work is mainly on how to simulate or realize human learning behaviors. It acquires new knowledge or skills and reorganizes existing knowledge structures to continually improve their performance. Helping computers recognize human language and operating habits is a key to this technology.

4.1 Types of Functions Required for Machine Learning

Before, we study the image adaptive processing method under machine learning, we should first understand what the basic functions of the machine itself are. The experimental study of the Turing test is the earliest test of machine learning human language habits and operational habits. The specific test content is: If the computer can answer the test questions raised by humans, and whether it is correct or not, it is impossible to tell whether the answer is given by humans or computer, so that machine learning is completed. From this test aspect, the staff can see that machine learning mainly learns how to simulate human intelligence to answer questions. This requires it to have the ability to identify the problem, including the scanning function of the actual object and the setting of the voice system.

4.2 Collection and Analysis of Image Data

The basic research of machine learning technology is the habit of thinking, and this is the analysis of data in image adaptive processing. The researchers applied image data processing techniques to statistically report the corresponding results, and analyzed the common points and personality points of the images through artificial intelligence technology. The purpose of establishing a database is that the computer needs to continuously learn in the process of data collection, and constantly simulate the human mindset to achieve intelligent image processing. After collecting the image data, it is also necessary to screen out some useless image data, such as noise in the image. These are the key research work of machine learning technology before image adaptive processing.

4.3 Combination of Machine Learning and Specific Work Content

Researchers who want to apply machine learning to image adaptive processing need to be flexible in combination with the specific content of image processing. For example, according to images of different precisions, the difference between rough processing and fine processing is involved. When processing images of different requirements, it is necessary to amplify different noise data and the like. At the same time, image processing needs to count the same type of image data and distinguish different types of images. In the process of machine learning, it is necessary to have the ability to intelligently and automatically distinguish image formats and contents. This must consider the generalization ability of the learning algorithm and ensure the low error rate of the test data set. The research of generalization ability mainly includes: describing the generalization ability of the model by the number of samples approaching infinity; establishing a model from the “limited sample” to estimate its ability to be true to the world.

5. Conclusion

In the image adaptive processing, the traditional processing method is time consuming and requires high professional requirements for the staff. Traditional methods are prone to operational errors and adversely affect subsequent analysis work. Based on this, the application advantages of artificial intelligence technology are gradually taken seriously by relevant staff. This paper mainly introduces natural language technology and machine learning in artificial intelligence technology.

The relevant staff needs to clarify the basic operating principles of these two technologies, and develop a scientific and rational work plan in combination with the process of image adaptive processing to establish a system of physical structure.

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