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VIDEO IMAGE DE-FOGGING RECOGNITION BASED ON RECURRENT NEURAL NETWORK

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ABSTRACT - Fog and haze make the photo degraded, and seriously affect the ordinary operation of the records device inside the fields of military, transportation and protection monitoring. Under this condition, the image de-fogging is of great significance. In order to meet the needs of real-time processing of existing video's de fogging process, a recognition algorithm based on recurrent neural network is proposed in this project. We use sparse automatic coding machine to extract the texture features of the image, and extract all kinds of fog related color features. Then, we use the recurrent neural network to implement sample training process, and we obtain the mapping relationship between texture structure features and color features and scene depth, and then we estimate the scene deep map of fog images. Finally, the atmospheric scattering model is used to recover the fog free image according to the scene deep map. Experiments show that the proposed algorithm can effectively obtain the scene depth of the image, and recover the ideal fog free image.

Keywords: Recurrent neural network, Video image, de-fogging recognition algorithm.

INTRODUCTION

Most of the time climate decides the quality of an image. Fog , haze and other bad weather, there are some water droplets or dust particles in the atmosphere, which results in the scattering or absorption of light during the propagation. At this point, the images taken outdoors are often blurred and the contrast degree is low. As a result, the system performance of monitoring devices has declined sharply, and even cannot operate properly. Therefore, it is of great significance to implement de fogging process. At present, the methods of image de fogging are mainly divided into two categories. One of them is based on image enhancement method, that is, by enhancing the contrast of the image to achieve the purpose of de fogging. This method can be applied and then existing nature processing algorithm, and haze image can get better fog removal effect. Another one is based on physical model, this method studies the objective mechanism of some atmospheric fog and image degradation, builds the atmospheric scattering model, and then recovers the fog image according to the physical model.

Artificial neural network is a branch of machine learning field. Deep learning stems from the artificial neural network, which can better simulate the brain structure, realize the abstraction process of cognitive process, and solve the problem of insufficient depth. There are many branches of deep learning, and the current research focuses are the convolutional neural network and recurrent neural network. RNN is a network system with strong learning ability. It can process several related information, which is suitable for processing time series data, such as speech recognition, text generation, machine translation, sequence prediction, etc. . In order to calculate the error value of each layer network, RNN usually uses the back

propagation through time algorithm (BPTT)[1]. However, BPTT cannot solve the problem of long time dependence, so the algorithm will bring about gradient disappearance and gradient explosion. In order to solve the problem of gradient vanishing and gradient explosion, we optimize the learning algorithm and configuration network.

RECURRENT NEURAL NETWORK

The network structure of RNN includes input layer, hidden layer and output layer. In theory, RNN can learn the knowledge of arbitrary length sequences. However, as intervals increase, it becomes difficult for RNN to learn the relationship between the connections, resulting in a time dependent problem.

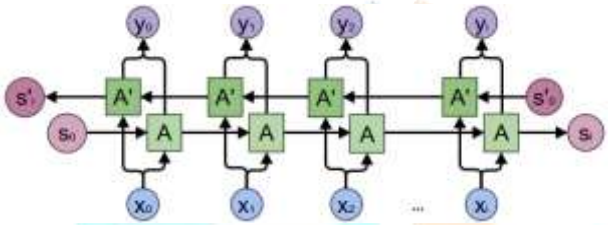


Fig. 1. Structure of LSTM.

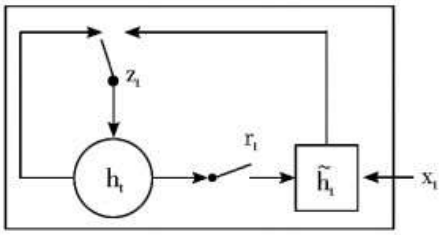


Fig. 2. Structure of GRU.

LSTM structure can learn long time dependence knowledge, and its core idea is memory cell and gate mechanism, as shown in Fig. 1. Memory cells run throughout the chain, with only a small amount of interaction in the middle, which ensures smooth and stable flow of information. The gate mechanism selectively allows information to pass through, adding or deleting information to neurons [2], [3].

The forgetting gate of LSTM is expressed as follows:

$$f_t = s\ W(\ _f \bullet [h_{t-1}, x_t\ ] + b_f) \quad (1)$$

The input gate of LSTM is expressed as follows:

$$i_t = s\ W(\ _i \bullet [h_{t-1}, x_t\ ] + b_i) \quad (2)$$

The cellular renewal expression of LSTM is as follows:

$$c_t = f_t * c_{t-1} + i_t * \bar{c}_t \quad (3)$$

The output gate of LSTM is expressed as follows:

$$o_t = s\ W(\ _o \bullet [h_{t-1}, x_t\ ] + b_o) \quad (4)$$

$$h_t = o_t * \tanh(c_t) \quad (5)$$

Inspired by the LSTM model gate mechanism, the GRU structure combines the input and the forgotten gates of the LSTM structure into a single update gate, and merges the memory cell and the implicit state, as shown in Fig. 2. The update gate expression of GRU is as follows:

$$z_t = s\ W(\ _z \bullet [h_{t-1}, x_t\ ]) \quad (6)$$

The reset gate expression of GRU is as follows:

$$r_t = s\ W(\ _r \bullet [h_{t-1}, x_t\ ]) \quad (7)$$

The output gate of GRU is expressed as follows:

$$\bar{h}_t = \tanh(W \bullet [h_{t-1} * r, x_{tt}\ ]) \quad (8)$$

$$H_t = -(1 - z_t) * h_{t-1} + z_t \bar{h}_t \quad (9)$$

The expressions of the ReLU function and the softplus function are respectively:

$$f(x) = max(0, x) \quad (10)$$

$$f(x) = \ln(1 + e^x) \quad (11)$$

In this article, we use the *ReLU* activation function and the *softplus* activation function in RNN. Compared with the traditional *tanh* function and the *sigmoid* function as shown in Fig. 3, our method can deal with the gradient vanishing problem [4]-[5].

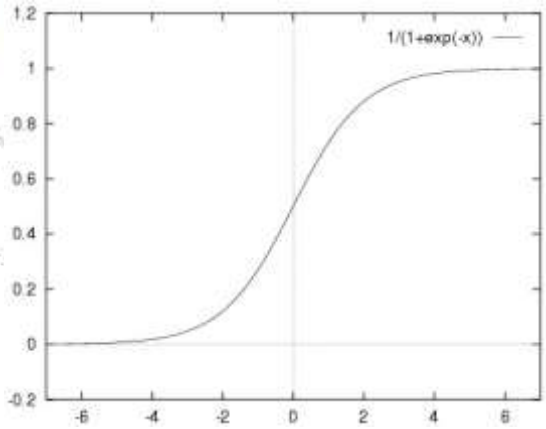


Fig. 3. Sigmoid function.

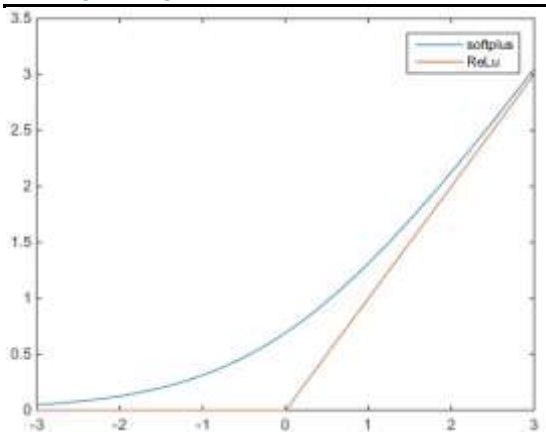


Fig .4 . ReLU and softplus function.

Because in the process of back propagation, the propagation of error information is closely related to the derivative of activation function and the simplified expression of error propagation is as follows:

$$E = \partial \cdot_E \quad f\,net'(_1) \cdot \cdot W_1 f\,net'(_2) \cdot \cdot \cdot \ldots\, W_n f\,net'(_n \qquad) \tag{12}$$

As shown in Fig. 4, for network learning, *softplus* function will provide more space for the network, and improve the learning ability of the model.

In the context of artificial neural networks, the rectifier is an activation function defined as (10) where x is the input to a neuron. This activation function was first introduced to a dynamical network by Hahnloser et al. in a 2000 paper in Nature. It has been used in convolutional networks more effectively than the widely used logistic sigmoid (which is inspired by probability theory) and its more practical counterpart, the hyperbolic tangent [7].

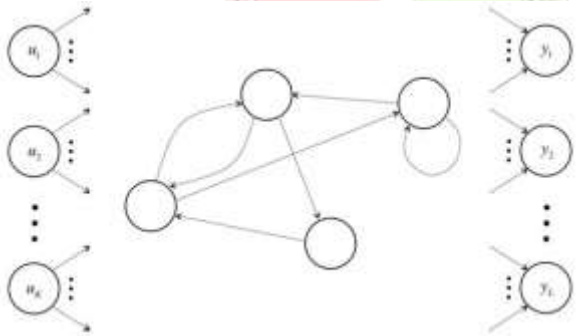


Fig. 5. Directed cyclic structure of RNN.

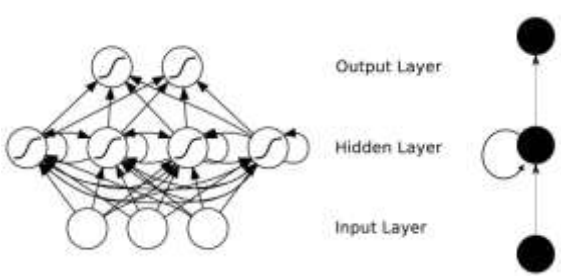


Fig.6. Typical structure of RNNs.

EXISTING SYSTEM

To meet the needs of real-time processing of existing video's de fogging process, a recognition algorithm based on recurrent neural network is proposed in this paper, and experiments show that the proposed algorithm can effectively obtain the scene depth of the image, and recover the ideal fog free image. There are two main technical difficulties in the image de-fogging method.

(1) Atmospheric light is estimated in conformity with stand afterwards without difficulty disturbed by using clean areas certain as much the expanse while propulsion in imitation of the overvaluation.

(2) The calculation about transmittance is easy according to outturn unreasonable ground fluctuation, as leads to the discount about its reliability

DE-FOGGING ALGORITHM OF VIDEO IMAGE

I. A. ATMOSPHERIC SCATTERING MODEL

In [8], Influenced by fog, haze and other environmental factors, the impurities in the air will affect the direct observation of human vision, which also blur the definition of the scene. Therefore, the effective restoration of scene clarity plays an important role in image processing and pattern recognition.

The atmospheric scattering model is mainly composed of the incident light attenuation model and the atmospheric optical imaging model.

$$I(\,)x = J\,x\,t\,x(\,)\,(\,) + A(1-t\,x(\,)) \tag{20}$$

where $I(\,)x$ is the actual observed fog image; $J(\,)x$ is the

processed image; A represents the global atmospheric light; $t\ x(\,)$ is the transmittance of medium; $J(\,)\,(\,)x\ t\ x$ represents the attenuation model of incident light; $A(1-t\ x(\,))$ represents the atmospheric optical imaging model.

II. B. FOG RESTORATION MODEL

The observed fog images are known. In order to recover the clear fog free images, we replace some parameters in above equations. Thus, we have:

$$t\,x(\,) = -1 - {}^{T\,x(\,)}$$

$$\frac{}{A} \quad (21)$$

$$I(\,)x = J\,x(\,)(1 - {}^{T\,x(\,)}) + T\,x(\,)$$

(22) *A*

We can reconstruct the fog free clear image by substituting the parameters of transmittance and global atmospheric light into fog image restoration model.

III. C. COLOR SPACE CONVERSION MODULE

In video image display, the general display does not support the YCrCb format, and the YCbCr4:2:2 data format is obtained by ADV7180 decoding.

We need to convert YUV4:2:2 to YCbCr4:4:4, and we obtain video data of YCbCr4:4:4, where Y, Cb and Cr are respectively 8-bits data.

We assign Cb and Cr to the next two image pixels. Then, the YCrCb format video image data is converted into the format data of RGB color space. The conversion formulas of YCrCb and RGB are as follows:

$$R = 1.164(Y - 16) + 1.596(Cr - 128) \quad (23)$$

$$G = 1.164(Y - -16)0.813(Cr - 128) + 0.391(Cb - 128) \quad (24)$$

$$B = 1.164(Y - 16) + 2.018(Cb - 128) \quad (25)$$

After decoding processing, Y, Cb and Cr are 8 bit data. Because the color component ADV7123 requires 10 bits data, so we need to shrink both sides of the formula of 128 times at the same time.

IV. D. IMAGE STORAGE MODULE

The main function of SDRAM (Synchronous Dynamic Random Access Memory) is to cache the odd and even field signals in the video signal, and read the cached video data, and then output the video signal to form a complete frame image. The SDRAM control module mainly controls the initialization of SDRAM, read-write control, automatic refresh, etc..

After the SDRMA initialization process, we can do read and write operations on SDRMA. We design a control module to drive the SDRAM memory. The driver module is mainly divided into the controller module and the data flow module. The controller module completes the initialization of power on, automatic refresh, read and write control, etc..

PROPOSED SYSTEM

Our proposed system consist of the existed system with some improvements. first of all a gray scale and guided filtered image will be produced. then processing will be takeplace.so we can get an output image of most de hazed. Algorithms have the effect of de fogging for the region scene. Although the proposed method achieved the effect of de fogging, the overall visual feeling does not seem to meet the visual effect; the recovery effect is not so natural. However, the results obtained by our algorithm are more realistic and follow human visual effect.

It also has an interface with telegram. In telegram we are creating a bot and create a group. Through this group we can send hazed images to the system and get results to the telegram

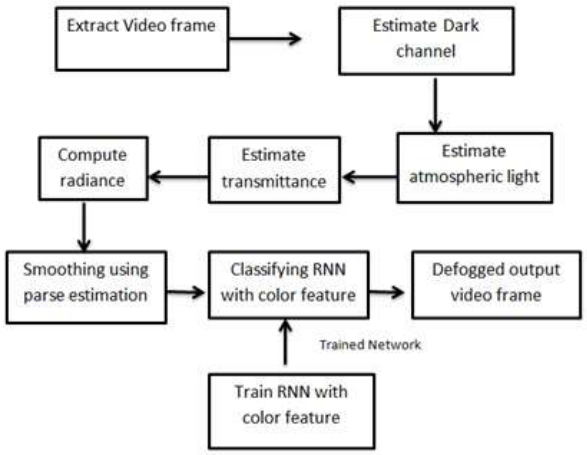
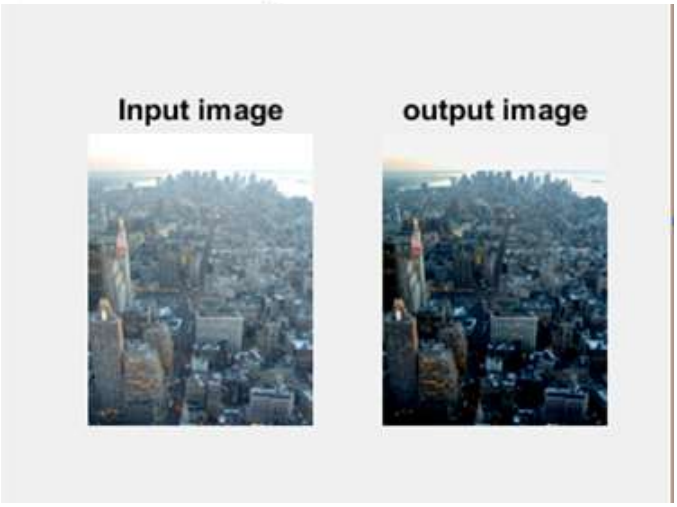


Figure 1.BLOCK DIAGRAM WORKING



INPUT AND OUTPUT IMAGES

CONCLUSION

Image is one of the essential approaches of human cognition. With the development of technological know-how and technology, photograph processing develops very hastily, and the de fogging era of video snap shots an vital research subject matter. On this paper, an photograph de-fogging set of rules based totally on recurrent neural community is proposed. Firstly, we use sparse automatic coding machine to extract the texture features of the image, and extract all kinds of the fog related color features. Then, we use recurrent neural network to implement sample training process, and we obtain the mapping relationship between texture structure features and color features and scene depth, and then we estimate the scene deep map of fog images. Finally, the atmospheric scattering model is used to recover the fog free image according to the scene deep map. Experiments show that the proposed algorithm can effectively obtain the scene depth of the image, and recover the ideal fog free image.

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