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Stability of Neural Networks Dependent on Time Series in Anime Image Recognition

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Abstract: Time series and neural networks have profoundly affected the fields of artificial intelligence and machine learning. It can be applied to tasks such as image recognition and target detection with high accuracy. In order to solve the shortcomings of the existing time series neural network animation image recognition stability research, this paper discusses the time series model stationarity, animation image image feature extraction and the functional equation of neural network loss. The dataset and parameter settings for sequential neural network animation image recognition applications are briefly introduced. And the work flow design of the time series neural network animation image recognition system structure model is discussed, and finally the stability of the time series neural network in animation image recognition is compared with the machine learning SVF, FCN model and RFC model. The experimental data show that the average absolute error of the time series neural network model in animation image recognition is small. When the number of iterations is 50-250, the average absolute error of the time series neural network model is less than 2%, while the machine learning SVF, FCN The average absolute error of the model and the RFC model is greater than 10%, so it is verified that the time series neural network model has a faster convergence speed and higher stability in animation image recognition.

1. Introduction

With the massive growth of images and network resources, the field of animation images has gradually got rid of the shackles of traditional image recognition technology, especially the emergence of neural network models, network resources and neural network models have objectively become the driving factors for the development of current animation image recognition technology one.

Nowadays, more and more scholars pay attention to the research of various technologies and platforms in animation image recognition, and through practical research, they have also achieved certain research results. Baldini G developed different techniques to show how neural networks work for image tasks. Neural networks can also be useful in other fields, such as time-series image classification, recognition, or image language processing. Baldini G applies image visualization algorithms to neural networks and time series. Baldini G makes time series recognition as easy to operate as neural network image recognition tasks by building image features, image categories, and image structures [1]. Corti E improves the application capabilities of deep neural networks in many applications such as image recognition and object localization. Combining deep convolutional neural networks with time series classification. Corti E has recently proposed a neural network model for image recognition based on data augmentation techniques based on dynamic time series. It is found through experiments that when this method is used for image recognition, data augmentation can significantly improve the accuracy of neural networks on some image recognition datasets [2]. Chithra P L focuses on the classification of extracted image features using probabilistic neural networks. Secondly, Chithra P L suggested to make up for the shortcomings of the original image recognition by replacing the activation function in the probabilistic neural network with a complex exponential function. The method proposed by Chithra P L reduces the image recognition time and complexity of neural networks, i.e. fast image recognition and convergence to neural network models. Chithra P L describes a method for comparing recognition methods using a visual object category dataset in the context of image feature extraction, validating the classification accuracy of extracted image features using a probabilistic neural network [3]. Although the existing research on animation image recognition is very rich, the research on the application of neural network animation image recognition relying on time series is still insufficient.

Therefore, in order to solve the problems existing in the existing research on time series-dependent neural network animation image recognition, this paper firstly introduces the concept of time series model stationarity, animation image image feature extraction and the functional equation of neural network loss. The data set and parameter settings of the neural network animation image recognition application of time series. Finally, the model architecture of the neural network animation image recognition application relying on time series is designed, and the stability of the neural network application relying on time series is compared with machine learning SVF and FCN. The model is compared with the RFC model, and the final experiment shows the reliability of the time series neural network proposed in this paper in animation image recognition.

2. Neural Network Animation Image Recognition Relying on Time Series

2.1. Neural Network Loss Function

The loss function can calculate the distance between the output value of the model and the real value in the neural network. The smaller the value is, the closer the result obtained by the model is to the real data, and the higher the reliability of the model [4]. Commonly used loss functions are mean absolute error loss function and SVM [5].

(1) Mean absolute error

The mean absolute error loss function can complete the identification of the actual value [6]. Its expression form is shown in formula (1):

$$MGH = \frac{1}{G}\sum_{u=1}^{G}\left\| i_u - t \right\|^2 \tag{1}$$

Among them, $t = m(k \cdot j + h)$ represents the recognition result of the network model, j represents the input value of the model, and k and h are the parameters of the neural network [7]. G represents an image volume in Caltech-256ob and PASCAL(2021) and i_u represents the ground-truth of the u -th image [8].

(1) SVM

For some linear inseparable animation images, SVM loss function introduces animation image recognition variables [9]. Its mathematical expression is shown in formula (2):

$$R(i(k \cdot j + h)) = [1 - i](k \cdot j + h)_\eta \tag{2}$$

Among them, "η" represents the function of the actual value of the animation image, as shown in formula (3):

$$[F]_\eta = \begin{cases} F, F > 0 \\ 0, \quad F \le 0 \end{cases} \tag{3}$$

In the above formula, the SVM loss function has strict requirements on the network model. In the process of animation image recognition stability analysis, the model can correctly classify and recognize animation images [10]. And when the confidence is high enough, the value of SVM loss will be equal to zero [11].

2.2. Time Series Model Stationarity

(1) Stationarity test and stabilization

Stationarity test is to judge the stationarity of the sequence by observing the features displayed by the time series graph and the autocorrelation coefficient graph [12].

(2) Pure randomness test

The pure randomness test is performed to judge whether the sequence contains useful information, and it is fitted by selecting an appropriate time series model [13].

(3) Parameter estimation and model testing

After determining the order of the model, it is necessary to carry out the significance test of the parameters and the validity of the model to judge whether the model is suitable [14].

2.3. Anime Image Feature Extraction

The related algorithms of animation image feature extraction are as follows:

(1) SIFT algorithm

The SIFT operator is a large-scale space-based image local property invariant operator that maintains invariance to changes such as image compression and flipping [15]. The extracted image feature points are guaranteed to have a considerable degree of accuracy for picture rotation, noise, etc. [16].

(2) Form the context

It is an image morphological feature descriptor, which can well describe the morphological characteristics of the image, and is a common image morphological feature description method [17]. In complex environments, contour features can also be easily perceived. Instead, it is used to describe the boundary contour information [18].

3. Research on the Stability Analysis of Animation Image Recognition Based on Neural Network Based on Time Series

3.1. Stability Analysis Dataset of Time Series-Dependent Neural Network in Animation Image Recognition

The experiments in this paper use two public datasets: Caltech-256ob and PASCAL(2021). Two datasets were chosen to show the stability of the neural network algorithm. The anime-style dataset is captured every 180 frames in some animes, and then augmented by data augmentation, and finally cropped into 256X256 images, a total of 621 images. The specific PASCAL(2021) dataset is shown in Table 1:

Table 1. Dataset settings

Data set	Years	Category	Total number of images	Minimum number of images	Maximum number of images	Average number of images
PASCAL(2021)	(2021)	265	621	80	624	105
Caltech-256ob	(2021)	254	789	90	712	116

3.2. Parameter Setting of Time Series-Dependent Neural Network in Animation Image Recognition Stability Analysis

In order to verify the stability of the proposed time series neural network model for animation image recognition, this paper compares the time series neural network model with machine learning SVF, FCN model and RFC model. Experiments are performed on datasets Caltech-256ob and PASCAL (2021) respectively. In the experiment, in order to facilitate the comparison of neural network models of time series, the maximum number of iterations is set to 2000 times. The experimental parameter settings of SVF model, FCN model and RFC model are shown in Table 2 and Table 3:

Table 2. Dataset caltech-256ob parameter settings

Model	Parameter settings
SVF	Loss coefficient C=5, the kernel function is a radial basis function,gamma=3
FCN	Loss coefficient C=7, kernel function is radial basis function,gamma=5
RFC	The number of decision trees is set to 200, and the maximum tree depth is set to 6

Table 3. Dataset PASCAL (2021) parameter settings

Model	Parameter settings
SVF	Loss coefficient C=3, kernel function is radial basis function, gamma=2.5
FCN	Loss coefficient C=5, kernel function is radial basis function, gamma=3.5
RFC	The number of decision trees is set to 350, and the maximum tree depth is set to 10

4. Research on Stability Analysis and Application of Neural Network Based on Time Series in Animation Image Recognition

4.1. Model Structure of Time Series-Dependent Neural Network in Animation Image Recognition

Based on the complexity of animation image recognition, combined with the respective advantages of time series model and neural network model, this paper proposes a combined animation image recognition model based on time series model and neural network model, abbreviated as ARI-BP combined recognition model, The combined prediction model can effectively capture the linear and nonlinear characteristics of animation images. The implementation process of the ARI-BP combined recognition model is shown in Figure 1:

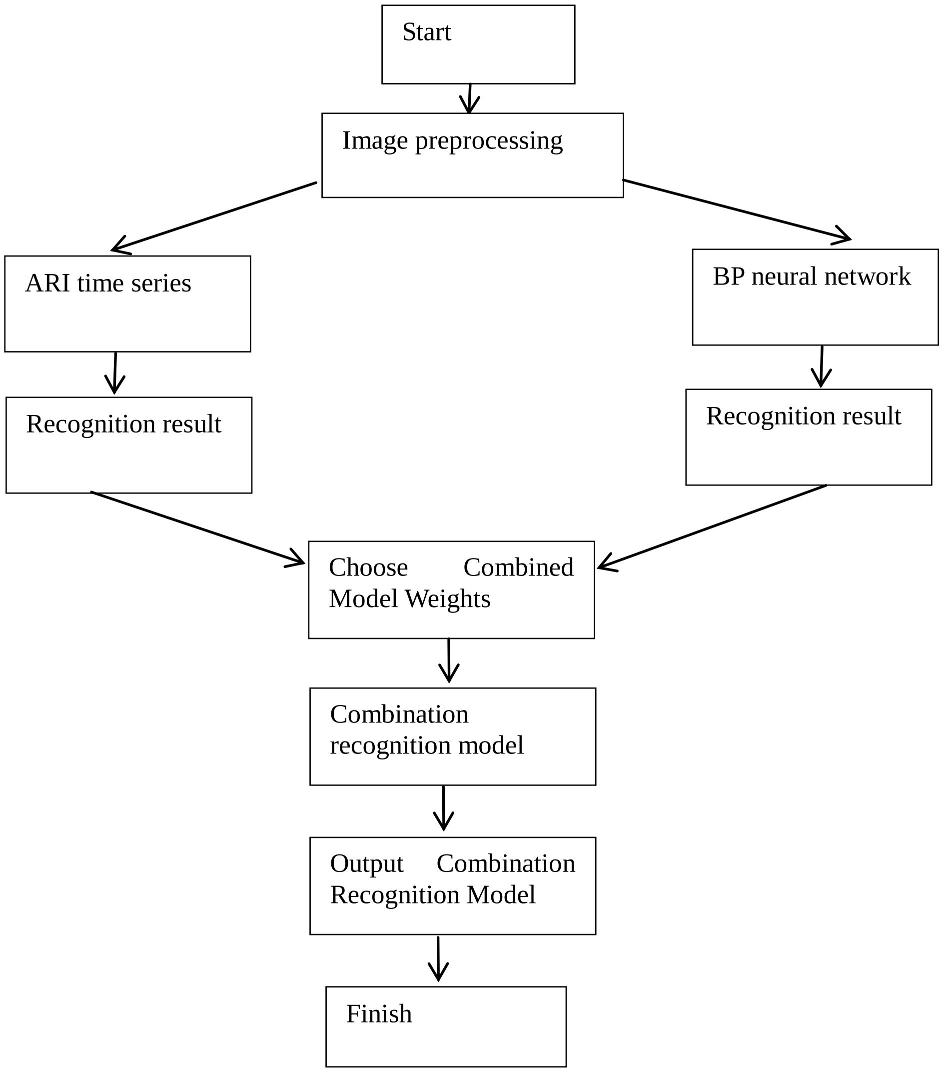

Figure 1. Time series-dependent neural network in anime image recognition model

The specific implementation steps of time series-dependent neural network in animation image recognition are as follows

(1) Anime image preprocessing. The datasets used in this paper are Caltech-256ob and PASCAL (2021) and some other image types related to anime images are also collected.

(2) ARI time series model construction. The ARI model is used to fit the regularity of the animation image sample data, the model is tested for the constructed model, the optimal model is selected, and the animation image data is identified.

(3) Construction of BP neural network prediction model. Firstly, the animation images are classified, that is, the content and size of the animation images are classified, and the animation images with high recognition are selected as the input of the neural network. Secondly, carry out the design of the network, and determine the parameters of the neural network, the number of neurons,

and the learning rate. Finally, the trained neural network is used to recognize the anime images.

(4) Select the combined model weights. After the construction of the ARI time series model and the BP neural network measurement model is completed, different weights are set according to the recognition performance and effects of the above two models to complete the construction of the combined prediction model.

(5) Output the recognition result. The recognition result of the combined prediction model is output, and the result is used as the final recognition result.

4.2. Stability Analysis and Application of Time-Series-Dependent Neural Network in Animation Image Recognition

For the time series-dependent neural network (ARI-BP) in the animation image recognition stability analysis, the mean absolute error between the model and the actual value of the animation image reflects the convergence speed and stability of the network model. Therefore, this paper uses the mean absolute error as the evaluation index of the recognition stability of the time series neural network combination model (ARI-BP) and the machine learning SVF, FCN model and RFC model. Figure 2 shows the mean absolute error curves of the four models on the animation image datasets Caltech-256ob and PASCAL(2021).

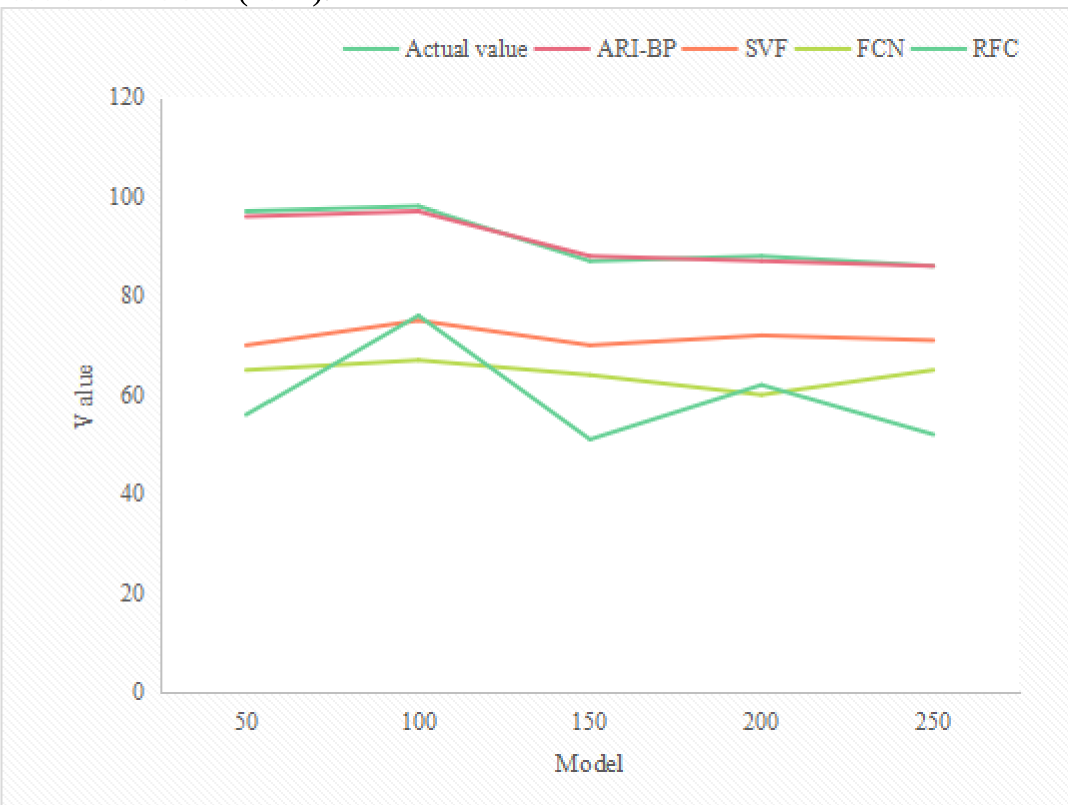

Figure 2. Mean absolute error comparison

Figure 2 shows the mean absolute error curve of animation recognition for the four models on the datasets Caltech-256ob and PASCAL(2021). It can be seen that on the datasets Caltech-256ob and PASCAL(2021) when the number of iterations is between 50 and 250, the proposed time series neural network model tends to be stable in animation recognition, and it is obviously close to the actual situation of animation image recognition. value, and the mean absolute error is small. However, the machine learning SVF, FCN model and RFC model are quite different from the actual value of animation recognition, so the average absolute error is large, and the animation image recognition is in an unstable state. The neural network model of the time series has the fastest convergence. The stability of animation image recognition is high, which means that the stability and convergence speed of the time series neural network model proposed in this paper are better than machine learning SVF, FCN model and RFC model.

5. Conclusion

This paper specifically introduces the technical basis of animation image recognition in time series neural network, including the introduction of time series model stationarity, animation image image feature extraction and neural network loss function, as well as animation image recognition in time series neural network The specific deployment process of the dataset and parameters is set, and the architecture of the animation image recognition implementation in the time series neural network is emphatically designed. The recognition stability of the time series neural network combination model (ARI-BP) and the machine learning SVF, FCN model and RFC model was tested by using the mean absolute error as the evaluation index, and the stability of the time series neural network animation image recognition was verified. It can meet the actual needs of animation image recognition applications.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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