

IMAGE QUALITY EVALUATING METHOD AND IMAGE QUALITY EVALUATING SYSTEM

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5 filed on September 8, 2017, all contents of which are incorporated herein by reference in
its entirety.

TECHNICAL FIELD

The present invention relates to the field of image processing technologies, and in
particular to an image quality evaluating method and an image quality evaluating system.

10 BACKGROUND

With wide application of Optical Character Recognition (OCR) technology, more
and more attention is paid to quality of a text image acquired by OCR technology. A
quality evaluating method for the text image arouses wider interests in academia and
industry.

15 Existing image quality evaluating methods can be categorized as two main groups.
One category refers to image quality evaluating methods with reference images, and the
other category refers to image quality evaluating methods without reference images. An
image quality evaluating method with a reference image refers to performing a feature
(such as gradient, contrast, etc.) comparison between a distorted image and an original
20 image to obtain quality evaluation of the distorted image. An image quality evaluating
method without a reference image refers to extracting some features of the distorted
image directly (such as edge strength, blur degree, etc.) to obtain the quality evaluation of
the distorted image according to the extracted features. The existing image quality
evaluating methods have disadvantages of complex algorithm and large amount of
25 calculation. Further, in most of the existing image quality evaluating methods, an image
to be evaluated needs to be pre-processed, and then an evaluating operation may be
performed on the processed image to be evaluated. Therefore, an evaluating process is
complex. In addition, most existing image quality evaluating methods aim at a natural
scene image, and are not suitable for quality evaluation of the text image.

SUMMARY

In view of this, embodiments of the present invention provide an image quality evaluating method and an image quality evaluating system, in order to solve a problem of poor evaluation accuracy and low evaluation efficiency of existing image quality
5 evaluating methods, especially for an evaluating operation of a text image.

According to a first aspect, an embodiment of the present invention provides an image quality evaluating method. The image quality evaluating method includes generating an image quality evaluating model by using image samples; and performing an
10 evaluating operation on an image to be evaluated by using the image quality evaluating model.

In an embodiment of the present invention, the generating an image quality evaluating model by using image samples includes labeling reference quality index values of the image samples; generating a neural network structure according to the image
15 samples; and performing an iterative training operation, by using the image samples, on hierarchical parameters of the neural network structure to generate the image quality evaluating model.

In an embodiment of the present invention, the performing an iterative training operation, by using the image samples, on hierarchical parameters of the neural network structure to generate the image quality evaluating model includes inputting the image
20 samples into the neural network structure according to training parameters; calculating difference between output results of a Loss layer in the neural network structure and the reference quality index values; updating the hierarchical parameters of the neural network structure by using the difference, and iteratively recalculating the difference according to the updated neural network structure; and generating the image quality evaluating model
25 according to the neural network structure when the difference which is iteratively calculated reaches a preset threshold.

In an embodiment of the present invention, the training parameters include at least one of a total number of iterations, the sample number of per iteration, a test interval, a learning rate, a weight of each layer of an initialed neural network structure, a bias term,
30 and learning rates of the bias term and the weight of each layer of the initialed neural network structure.

In an embodiment of the present invention, the neural network structure includes a

Convolution layer, an Activation layer and a Loss layer.

In an embodiment of the present invention, the Activation layer includes a ReLU layer and a Sigmoid layer.

5 In an embodiment of the present invention, a hierarchical order in the neural network structure is the Convolution layer, the ReLU layer, the Convolution layer, the ReLU layer, the Convolution layer, the ReLU layer, the Sigmoid layer and the Loss layer.

In an embodiment of the present invention, the neural network structure further includes a Pooling layer, a Dropout layer, and a SPP layer.

10 In an embodiment of the present invention, the hierarchical order in the neural network structure is the Convolution layer, the ReLU layer, the Pooling layer, the Convolution layer, the ReLU layer, the Pooling layer, the Convolution layer, the ReLU layer, the Pooling layer, the Convolution layer, the ReLU layer, the Dropout layer, the Convolution layer, the SPP layer, the Sigmoid layer and the Loss layer.

15 In an embodiment of the present invention, hierarchical parameters of the Convolution layer include the number of convolution kernels, a size of the convolution kernel, a sliding step size of a convolution window, and a padding edge pixel value.

In an embodiment of the present invention, hierarchical parameters of the Pooling layer include a sampling rule, a size of a sampling window, and a sliding step size of the sampling window.

20 In an embodiment of the present invention, a hierarchical parameter of the Dropout layer includes a dropout rate.

In an embodiment of the present invention, hierarchical parameters of the SPP layer include a sampling rule and the number of pyramid layers.

In an embodiment of the present invention, the image refers to a text image.

25 According to a second aspect, an embodiment of the present invention provides an image quality evaluating system. The image quality evaluating system includes an image quality evaluating model generating module configured to generate an image quality evaluating model by using image samples; and an evaluating module configured to perform an evaluating operation on an image to be evaluated by using the image quality
30 evaluating model.

In an embodiment of the present invention, the image quality evaluating model generating module includes a labeling unit configured to label reference quality index values of the image samples; a neural network structure generating unit configured to

generate a neural network structure according to the image samples; and an iterative training unit configured to perform an iterative training operation, by using the image samples, on hierarchical parameters of the neural network structure to generate the image quality evaluating model.

5 In an embodiment of the present invention, the iterative training unit is further configured to input the image samples into the neural network structure according to training parameters; and calculate difference between output results of a Loss layer in the neural network structure and the reference quality index values; and update the hierarchical parameters of the neural network structure by using the difference, and
10 iteratively recalculate the difference according to the updated neural network structure; and generate the image quality evaluating model according to the neural network structure when the difference which is iteratively calculated reaches a preset threshold.

 In an embodiment of the present invention, the training parameters include at least one of a total number of iterations, the sample number of per iteration, a test interval, a
15 learning rate, a weight of each layer of an initialed neural network structure, a bias term, and learning rates of the bias term and the weight of each layer of the initialed neural network structure.

 In an embodiment of the present invention, the neural network structure includes a Convolution layer, an Activation layer, and a Loss layer.

20 In an embodiment of the present invention, the Activation layer includes a ReLU layer and a Sigmoid layer.

 In an embodiment of the present invention, a hierarchical order in the neural network structure is the Convolution layer, the ReLU layer, the Convolution layer, the ReLU layer, the Convolution layer, the ReLU layer, the Sigmoid layer and the Loss layer.

25 In an embodiment of the present invention, the neural network structure further includes a Pooling layer, a Dropout layer, and a SPP layer.

 In an embodiment of the present invention, the hierarchical order in the neural network structure is the Convolution layer, the ReLU layer, the Pooling layer, the Convolution layer, the ReLU layer, the Pooling layer, the Convolution layer, the ReLU
30 layer, the Pooling layer, the Convolution layer, the ReLU layer, the Dropout layer, the Convolution layer, the SPP layer, the Sigmoid layer and the Loss layer.

 In an embodiment of the present invention, hierarchical parameters of the Convolution layer include the number of convolution kernels, a size of the convolution

kernel, a sliding step size of a convolution window, and a padding edge pixel value.

In an embodiment of the present invention, hierarchical parameters of the Pooling layer include a sampling rule, a size of a sampling window, and a sliding step size of the sampling window.

5 In an embodiment of the present invention, a hierarchical parameter of the Dropout layer includes a dropout rate.

In an embodiment of the present invention, hierarchical parameters of the SPP layer include a sampling rule and the number of pyramid layers.

In an embodiment of the present invention, the image refers to a text image.

10 According to a third aspect, an embodiment of the present invention provides a computer readable storage medium storing an image quality evaluating program for executing a processor to execute the image quality evaluating method according to any one of the above embodiments.

In the image quality evaluating method according to the embodiments of the present invention, by means of generating the image quality evaluating model by using the image
15 samples, and then performing the evaluating operation on the image to be evaluated by using the image quality evaluating model, a quality evaluating operation for the image to be evaluated is completed. Compared with an existing image quality evaluating method, the image quality evaluating method according to the embodiments of the present
20 invention has advantages of low calculation amount, simple and fast evaluation process and high evaluation efficiency. In addition, in the image quality evaluating method according to the embodiments of the present invention, the evaluating operation is implemented by using the image quality evaluating model generated according to the image samples. Therefore, an evaluation result has high accuracy. In particular, when the
25 training image samples and the image to be evaluated are the text images, the image quality evaluating method according to the embodiments of the present invention can perform the evaluating operation with high accuracy and high efficiency.

In addition, the image quality evaluating system according to the embodiments of the present invention also has the above advantages and beneficial effects.

30 BRIEF DESCRIPTION OF DRAWINGS

In order to more clearly illustrate technical solutions in embodiments of the present

invention, accompanying drawings used in description of the embodiments will be briefly described below. It is obvious that the accompanying drawings in the following description are only some embodiments of the present invention. As for those skilled in the art, other accompanying drawings may also be obtained from the accompanying drawings without any creative effort.

FIG. 1 shows a schematic flowchart of an image quality evaluating method according to an embodiment of the present invention.

FIG. 2 shows a schematic flowchart of a step of generating an image quality evaluating model by using image samples of an image quality evaluating method according to an embodiment of the present invention.

FIG. 3 shows a schematic hierarchical structure diagram of a neural network structure according to another embodiment of the present invention.

FIG. 4 shows a schematic hierarchical structure diagram of a neural network structure according to still another embodiment of the present invention.

FIG. 5 shows a schematic flowchart of a step of performing an iterative training operation, by using image samples, on hierarchical parameters of a neural network structure to generate an image quality evaluating model of an image quality evaluating method according to yet still another embodiment of the present invention.

FIG. 6 shows a method flowchart of iteratively training an image quality evaluating model according to yet still another embodiment of the present invention.

FIG. 7 shows example diagrams of text image samples for training according to yet still another embodiment of the present invention.

FIG. 8 shows a schematic structural diagram of a text quality network structure of a text image quality evaluating model according to yet still another embodiment of the present invention.

FIG. 9 shows a schematic size change diagram of a grayscale image of $M \times N$ outputted from layers of a text quality network structure according to yet still another embodiment of the present invention.

FIG. 10 shows a schematic flowchart of performing a text image quality evaluating operation by using a trained text image quality evaluating model according to yet still another embodiment of the present invention.

FIG. 11 shows an example diagram of an image to be evaluated according to yet still another embodiment of the present invention.

FIG. 12 shows an example diagram of an image to be evaluated according to yet still another embodiment of the present invention.

FIG. 13 shows a schematic structural diagram of an image quality evaluating system according to an embodiment of the present invention.

5 FIG. 14 shows a schematic structural diagram of an image quality evaluating model generating module of an image quality evaluating system according to another embodiment of the present invention.

FIG. 15 shows a schematic structural diagram of a text image quality evaluating equipment according to still another embodiment of the present invention.

10 FIG. 16 shows a schematic structural diagram of an electronic equipment according to an embodiment of the present invention.

DETAILED DESCRIPTION

In order to make objects, technical solutions and advantages of the present invention clearer, the technical solutions in embodiments of the present invention are clearly and
15 completely described in the following with reference to accompanying drawings in the embodiments of the present invention. Obviously, the described embodiments are only a part of the embodiments of the present invention, and not all of the embodiments. All other embodiments obtained by those skilled in the art according to the embodiments of the present invention without creative efforts are within the scope of the present
20 invention.

FIG. 1 shows a schematic flowchart of an image quality evaluating method according to an embodiment of the present invention. As shown in FIG. 1, the image quality evaluating method according to the embodiment of the present invention includes the following steps.

25 10: generating an image quality evaluating model by using image samples.

The image quality evaluating model refers to an image quality evaluating model generated by training according to the image samples. That is, specific information such as a hierarchical structure and hierarchical parameters of the image quality evaluating model are generated by training according to a specific situation of the image samples.

30 It may be noted that an image sample may be a scene image including a natural scene or a text image including text information. Thereby, adaptability and extensive

application of the image quality evaluating method according to the embodiments of the present invention may be fully improved. A type of the image sample is not uniformly limited in the embodiment of the present invention.

Preferably, a type of an image to be evaluated may be consistent with the types of the training samples. For example, when the training image samples are text images, the image to be evaluated may also be the text image. It may be understood that, since the image quality evaluating model is generated according to the image samples, when the type of the image to be evaluated is consistent with the types of the training samples, evaluation accuracy of the image quality evaluating model may be sufficiently improved.

In an embodiment of the present invention, the training image samples and the image to be evaluated are the text images.

20: performing an evaluating operation on the image to be evaluated by using the image quality evaluating model.

In an actual application process, firstly the image samples are selected and the image quality evaluating model is generated by using the selected image samples, and then the evaluating operation is performed on the image to be evaluated by using the generated image quality evaluating model to generate an evaluation value of the image to be evaluated.

In the image quality evaluating method according to the embodiments of the present invention, by means of generating the image quality evaluating model by using the training image samples, and then performing the evaluating operation on the image to be evaluated by using the image quality evaluating model, a quality evaluating operation for the image to be evaluated is completed. Compared with an existing image quality evaluating method, the image quality evaluating method according to the embodiments of the present invention has advantages of low calculation amount, simple and fast evaluation process and high evaluation efficiency. In addition, in the image quality evaluating method according to the embodiments of the present invention, the evaluating operation is implemented by using the image quality evaluating model generated according to the training image samples. Therefore, an evaluation result has high accuracy. In particular, when the image samples and the image to be evaluated are the text images, the image quality evaluating method according to the embodiments of the present invention can perform the evaluating operation with high accuracy and high efficiency for the text image.

FIG. 2 shows a schematic flowchart of a step of generating an image quality evaluating model by using image samples of an image quality evaluating method according to an embodiment of the present invention. As shown in FIG. 2, in the image quality evaluating method according to the embodiment of the present invention, the step of generating an image quality evaluating model by using image samples includes the following steps.

11: labeling reference quality index values of the image samples.

It may be noted that, a labeling manner of the reference quality index value of each image sample may be an automatic labeling manner implemented by a computer program, etc., or may be a manual labeling manner, or may be other labeling manners. The labeling manner is not uniformly limited in the embodiment of the present invention.

12: generating a neural network structure according to the image samples.

It may be understood that, the neural network structure is a network structure for assisting subsequent machine learning, including an input layer, an output layer and a middle layer.

Preferably, the neural network structure refers to a convolutional neural network structure.

Preferably, the neural network structure refers to a network structure including a Convolution layer, an Activation layer and a Loss layer. The Convolution layer is configured to perform a feature extracting operation on the image samples. The Activation layer is configured to introduce a nonlinear factor. The Loss layer is configured to determine whether or not to continue an iterative training operation according to difference between evaluation results and the reference quality index values during a training process.

Preferably, the Activation layer includes a Rectified Linear Unit (ReLU) layer and a Sigmoid layer.

More preferably, the neural network structure further includes a Pooling layer, a Dropout layer and a Spatial Pyramid Pooling (SPP) layer. The Pooling layer is configured to perform feature compression to simplify computational complexity and reduce over-fitting. The Dropout layer is configured to reduce the over-fitting. The SPP layer is configured to convert the extracted feature into a fixed size feature vector.

13: performing an iterative training operation, by using the image samples, on hierarchical parameters of the neural network structure to generate the image quality

evaluating model.

Preferably, hierarchical parameters of the Convolution layer include the number of convolution kernels, a size of the convolution kernel, a sliding step size of a convolution window, and a padding edge pixel value.

5 Preferably, hierarchical parameters of the Pooling layer include a sampling rule, a size of a sampling window, and a sliding step size of the sampling window.

Preferably, a hierarchical parameter of the Dropout layer includes a dropout rate.

Preferably, hierarchical parameters of the SPP layer include a sampling rule and the number of pyramid layers.

10 In an actual application process, firstly the image samples are selected, and the reference quality index values of the image samples are labeled, and then the neural network structure is generated according to the selected image samples, and the iterative training operation is performed on the hierarchical parameters of the neural network structure by using the image samples to generate the image quality evaluating model,
15 finally the evaluating operation is performed on the image to be evaluated by using the generated image quality evaluating model to generate an evaluation value of the image to be evaluated.

In the image quality evaluating method according to the embodiments of the present invention, by means of establishing the basic neural network structure according to the
20 image samples, and then performing a deep machine learning on the neural network structure according to the image samples to generate the image quality evaluating model, evaluation accuracy of the image quality evaluating model is further improved. In addition, when the neural network structure includes a hierarchical structure such as the ReLU layer, the Sigmoid layer, the Pooling layer, the Dropout layer, and the SPP layer,
25 etc., the evaluation accuracy and evaluation efficiency of the generated image quality evaluating model are further improved.

FIG. 3 shows a schematic hierarchical structure diagram of a neural network structure according to another embodiment of the present invention. As shown in FIG. 3, in the neural network structure according to the embodiment of the present invention, a
30 hierarchical order is a Convolution layer, a ReLU layer, a Convolution layer, a ReLU layer, a Convolution layer, a ReLU layer, a Sigmoid layer and a Loss layer.

In an actual application process, a data transmission order is the Convolution layer, the ReLU layer, the Convolution layer, the ReLU layer, the Convolution layer, the ReLU

layer, the Sigmoid layer and the Loss layer. That is, data may be inputted from the Convolution layer located at a first layer, and finally outputted through the Loss layer.

FIG. 4 shows a schematic hierarchical structure diagram of a neural network structure according to still another embodiment of the present invention. As shown in FIG. 4, in the neural network structure according to the embodiment of the present invention, a hierarchical order is a Convolution layer, a ReLU layer, a Pooling layer, a Convolution layer, a ReLU layer, a Pooling layer, a Convolution layer, a ReLU layer, a Pooling layer, a Convolution layer, a ReLU layer, a Dropout layer, a Convolution layer, a SPP layer, a Sigmoid layer and a Loss layer.

In an actual application process, a data transmission order is the Convolution layer, the ReLU layer, the Pooling layer, the Convolution layer, the ReLU layer, the Pooling layer, the Convolution layer, the ReLU layer, the Pooling layer, the Convolution layer, the ReLU layer, the Dropout layer, the Convolution layer, the SPP layer, the Sigmoid layer and the Loss layer. That is, data may be inputted from the Convolution layer located at a first layer, and finally outputted through the Loss layer.

FIG. 5 shows a schematic flowchart of a step of performing an iterative training operation, by using image samples, on hierarchical parameters of a neural network structure to generate an image quality evaluating model of an image quality evaluating method according to yet still another embodiment of the present invention. As shown in FIG. 5, in the image quality evaluating method according to the embodiment of the present invention, the step of performing an iterative training operation, by using image samples, on hierarchical parameters of a neural network structure to generate an image quality evaluating model includes the following steps.

131: inputting the image samples into the neural network structure according to training parameters.

Preferably, the training parameters include at least one of a total number of iterations, the sample number of per iteration, a test interval, a learning rate, a weight of each layer of an initialed neural network structure, a bias term, and learning rates of the bias term and the weight of each layer of the initialed neural network structure.

132: calculating difference between output results of a Loss layer in the neural network structure and reference quality index values.

133: updating the hierarchical parameters of the neural network structure by using the difference, and iteratively recalculating the difference according to the updated neural

network structure.

134: generating the image quality evaluating model according to the neural network structure when the difference which is iteratively calculated reaches a preset threshold.

It may be noted that, the preset threshold may be set according to an actual situation,
5 so as to fully improve adaptability and extensive application of the image quality evaluating method according to the embodiments of the present invention. The preset threshold is not uniformly limited in the embodiment of the present invention.

In an actual application process, firstly the image samples are selected, the reference quality index values of the image samples are labeled, and the neural network structure is
10 generated according to the selected image samples, and then the training parameters are selected, the image samples are inputted into the generated neural network structure according to the training parameters, the difference between the output results of the Loss layer in the neural network structure and the reference quality index values is calculated, the hierarchical parameters of the neural network structure are updated by using the
15 difference, and the difference is iteratively recalculated according to the updated neural network structure, when the difference which is iteratively calculated reaches the preset threshold, the neural network structure corresponding to the difference is the image quality evaluating model, finally the evaluating operation is performed on the image to be evaluated by using the generated image quality evaluating model to generate an
20 evaluation value of the image to be evaluated.

FIG. 6 shows a method flowchart of iteratively training an image quality evaluating model according to yet still another embodiment of the present invention. In the embodiment of the present invention, the image samples and the image to be evaluated are text images.

25 In the embodiment of the present invention, the text image quality evaluating model needs to be trained in advance, and then quality of the text image (i.e., the image to be evaluated) may be evaluated according to the text image quality evaluating model.

As shown in FIG. 6, a process of training the text image quality evaluating model specifically includes the following steps.

30 101: obtaining text image samples for training, and labeling a quality index value for each of the text image samples.

It may be understood that, the quality index value mentioned in the step 101 refers to the reference quality index value mentioned in the above embodiments.

Specifically, the text image samples for training include text image samples obtained from a public text image quality database, and further include synthetic text image samples. Each of the text image samples may be one of a multi-spectral image, an color image or a gray image. The text of the image samples contains the text image of Chinese,
5 English or other phonetic characters.

The step of labeling a quality index value for each of the text image samples includes: labeling automatically by using a computer, for example, the recognition accuracy of OCR may be taken as the labeled quality index value of the text image; and/or manual labeling, by means of observing the text image by human eyes to label the
10 quality index value of the text image; and/or other manners for labeling the quality index value for the text image sample. A specific manner adopted for labeling is not limited in the embodiments of the present invention.

Among them, the quality index value of the text image may be expressed by a floating point number. The larger the floating point number, the better the quality of the
15 text image. After the step of labeling a quality index value for each of the text image samples, the process of training the text image quality evaluating model further includes scaling the labeled quality index values of all training text images to a range of floating point numbers of 0-0.1.

As an example, FIG. 7 shows example diagrams of text image samples for training
20 according to yet still another embodiment of the present invention. As shown in FIG. 7, four text images a, b, c and d in FIG. 7 may be used as the text image samples for training a text image quality evaluating model. The quality index values labeled for the four text image samples a, b, c and d are: 0.91, 0.8658, 0.2733 and 0.9067.

102: setting a text quality network of a text image quality evaluating model.

25 It may be noted that, the text image quality evaluating model is trained according to a convolutional neural network based on a deep learning. Therefore, a neural network structure needs to be set. That is, the neural network structure refers to the text quality network.

Firstly, a basic hierarchical structure of the text quality network structure is
30 established. Specifically, the text quality network structure includes five Convolution layers, four ReLU layers, three Pooling layers, one Dropout layer, one SPP layer, one Sigmoid layer and one Loss layer. A hierarchical order of the text quality network structure is Convolution / ReLU / Pooling / Convolution / ReLU / Pooling / Convolution /

ReLU / Pooling / Convolution / ReLU / Dropout / Convolution / SPP / Sigmoid / Loss.

As an example, FIG. 8 shows a schematic structural diagram of a text quality network structure of a text image quality evaluating model according to yet still another embodiment of the present invention. Specifically, FIG. 8 shows a schematic structural diagram of a hierarchical arrangement in the text quality network structure. CONV refers to convolution, POOL refers to Pooling, and DROP refers to Dropout.

Then, hierarchical parameters of the Convolution layers, the Pooling layers, the Dropout layer and the SPP layer in the text quality network structure are set.

Among them, the hierarchical parameters of each of the Convolution layers include the number of convolution kernels, a size of the convolution kernel, a sliding step size of a convolution window, and a padding edge pixel value. The hierarchical parameters of each of the Pooling layers include a sampling rule, a size of a sampling window, and a sliding step size of the sampling window. The hierarchical parameter of the Dropout layer includes a dropout rate. The hierarchical parameters of the SPP layer include a sampling rule and the number of pyramid layers.

Preferably, the hierarchical parameters of the Convolution layers, the Pooling layers, the Dropout layer, and the SPP layer are set as follows. In a first Convolution layer, the number of the convolution kernels is 96, the size of each of the convolution kernels is 3×3 , the sliding step size of the convolution window is 1, the padding edge pixel value is 0. In a first Pooling layer, the sampling rule is a maximum sampling, the size of the sampling window is 3, and the sliding step size of the sampling window is 2. In a second Convolution layer, the number of the convolution kernels is 96, the size of each of the convolution kernels is 3×3 , the sliding step size of the convolution window is 1, and the padding edge pixel value is 2. In a second Pooling layer, the sampling rule is the maximum sampling, the size of the sampling window is 3×3 , and the sliding step size of the sampling window is 2. In a third Convolution layer, the number of the convolution kernels is 128, the size of each of the convolution kernels is 3×3 , the sliding step size of the convolution window is 1, and the padding edge pixel value is 1. In a third Pooling layer, the sampling rule is the maximum sampling, the size of the sampling window is 3, and the sliding step size of the sampling window is 2. In a fourth Convolution layer, the number of the convolution kernels is 192, the size of each of the convolution kernels is 1, the sliding step size of the convolution window is 1, and the padding edge pixel value is 0. In the Dropout layer, the dropout rate is 0.35. In a fifth Convolution layer, the number of

the convolution kernels is 1, the size of each of the convolution kernels is 1, the sliding step size of the convolution window is 1, and the padding edge pixel value is 0. In the SPP layer, the sampling rule is the maximum sampling, and the number of the pyramid layers is 1.

5 It may be noted that setting values of the hierarchical parameters of the Convolution layers, the Pooling layers, the Dropout layer and the SPP layer shown above are preferred values. The setting values may be adjusted according to a need during an actual training process. One or more specific hierarchical parameters of each layer are not limited in the embodiment of the present invention.

10 103: performing an iterative training operation on parameters of an initial text image quality evaluating model, by using the text quality network according to the text image samples and the labeled quality index values, to obtain the text image quality evaluating model.

Specifically, a process of obtaining the text image quality evaluating model
15 mentioned in the step 103 includes the following steps.

a. determining training parameters.

Specifically, the training parameters include at least one of a total number of iterations, the sample number of per iteration, a test interval, a learning rate, a weight of each layer of an initialed neural network structure, a bias term, and learning rates of the
20 bias term and the weight of each layer of the initialed neural network structure.

b. inputting the text image samples into the initial text image quality evaluating model according to the training parameters.

c. obtaining output results of processing the text image samples by using the Convolution layers, the ReLU layers, the Pooling layers, the Dropout layer, the SPP layer,
25 and the Sigmoid layer of the text quality network.

Specifically, data of each text image sample for training is sequentially subjected to operations of the Convolution layers, the ReLU layers and the Pooling layers, and is subjected to network computing operations of the Dropout layer, the SPP layer and the Sigmoid layer. Thereby, the final output result is obtained in the Sigmoid layer.

30 d. calculating difference between the output results and the corresponding labeled quality index values in the Loss layer of the text quality network, and propagating the difference back to each layer of the text quality network structure to update the hierarchical parameters of each layer, and iteratively calculating until the difference

reaches a preset threshold.

Specifically, the step of updating the hierarchical parameters of each layer includes updating a weight of each layer of an initialed neural network structure.

FIG. 9 shows a schematic size change diagram of a grayscale image of $M \times N$ outputted from layers of a text quality network structure according to yet still another embodiment of the present invention. Further, in order to illustrate a training process, the grayscale image with a size $M \times N$ is taken as an example for description. The grayscale image of $M \times N$ is inputted into the text image quality evaluating model in training. The size change output by each layer of the text quality network structure of the text image quality evaluating model may be referred to FIG. 9, as follows.

A structure size returned by a first Convolution layer is $1 \times 96 \times M \times N$.

A structure size returned by a first Pooling layer is $1 \times 96 \times M/2 \times N/2$.

A structure size returned by a second Convolution layer is $1 \times 96 \times M/2 \times N/2$.

A structure size returned by a second Pooling layer is $1 \times 96 \times M/4 \times N/4$.

A structure size returned by a third Convolution layer is $1 \times 128 \times M/4 \times N/4$.

A structure size returned by a third Pooling layer is $1 \times 128 \times M/8 \times N/8$.

A structure size returned by a fourth Convolution layer is $1 \times 192 \times M/8 \times N/8$.

A structure size returned by a fifth Convolution layer is $1 \times 1 \times M/8 \times N/8$.

A structure size returned by a SPP layer is $1 \times 1 \times 1 \times 1$.

A structure size returned by a Sigmoid layer is $1 \times 1 \times 1 \times 1$.

Then, the difference between output results of the Sigmoid layer and the corresponding labeled quality index values of the text image samples may be calculated in the Loss layer, and the difference is returned to each of the above layers to update network parameters of each layer. The process is iterated by using a large number of text image samples until the difference in the Loss layer reaches a preset threshold.

e. obtaining a final generated text image quality evaluating model.

FIG. 10 shows a schematic flowchart of performing a text image quality evaluating operation by using a trained text image quality evaluating model according to yet still another embodiment of the present invention. As shown in FIG. 10, a process of implementing the text image quality evaluating operation by using the trained text image quality evaluating model includes the following steps.

501: obtaining a text image to be evaluated.

Specifically, the text image to be evaluated is similar to the text image samples in the

step 101 shown in FIG. 6, which will not be described herein again. The features of the text image samples mentioned in the step 101 may be used for the text image to be evaluated herein.

502: inputting the text image to be evaluated into a pre-trained text image quality evaluating model, and determining a quality index value of the text image to be evaluated according to an output value of the text image quality evaluating model.

The quality index value refers to a floating point number.

As an example, FIG. 11 is an example diagram of an image to be evaluated according to yet still another embodiment of the present invention. FIG. 12 is an example diagram of an image to be evaluated according to yet still another embodiment of the present invention. The text images shown in FIG. 11 and FIG. 12 are outputted from a pre-trained text image quality evaluating model for processing. A quality index value of the text image shown in FIG. 11 obtained by the processing is 0.9756, and a quality index value of the text image shown in FIG. 12 obtained by the processing is 0.9805.

15 In the image quality evaluating method according to the embodiments of the present invention, by means of obtaining the text image to be evaluated, inputting the text image to be evaluated into the pre-trained text image quality evaluating model, and determining the quality index value of the text image to be evaluated according to the output value of the text image quality evaluating model, quality of the text image may be specifically evaluated according to the pre-trained text image quality evaluating model. Meanwhile, the evaluating process is simple and easy to operate, and may be used as a pre-processing operation before OCR to reduce computational consumption. Compared with an existing image quality evaluating method in the prior art, the image quality evaluating method according to the embodiments of the present invention can greatly reduce calculation complexity and calculation amount. Meanwhile, compared with the prior art, the image is not required to be pre-processed, therefore, the evaluating process is fast. In addition, since the text image quality evaluating model is trained to generate according to a neural network based on a deep learning, human vision can be simulated to evaluate the quality of the text image during the evaluating process. Parameters of the text image quality evaluating model are iteratively trained repeatedly. Therefore, more effective and accurate quality evaluation results may be achieved and evaluation efficiency may be improved by using the pre-trained text image quality evaluating model to evaluate the text image.

FIG. 13 shows a schematic structural diagram of an image quality evaluating system

according to an embodiment of the present invention. As shown in FIG. 13, the image quality evaluating system according to the embodiment of the present invention includes:

an image quality evaluating model generating module 100 configured to generate an image quality evaluating model by using image samples; and

5 an evaluating module 200 configured to perform an evaluating operation on an image to be evaluated by using the image quality evaluating model.

It may be noted that the image quality evaluating model refers to an image quality evaluating model generated by training according to the image samples. That is, specific information such as a hierarchical structure and hierarchical parameters of the image
10 quality evaluating model are generated by training according to a specific situation of the image samples.

It may be noted that an image sample may be a scene image including a natural scene or a text image including text information. Thereby, adaptability and extensive application of the image quality evaluating method according to the embodiments of the
15 present invention may be fully improved. A type of the image sample is not uniformly limited in the embodiment of the present invention.

Preferably, a type of the image to be evaluated may be consistent with the types of the image samples. For example, when the image samples are text images, the image to be evaluated may also be the text image. It may be understood that, since the image
20 quality evaluating model is generated according to the image samples, when the type of the image to be evaluated is consistent with the types of the image samples, evaluation accuracy of the image quality evaluating model may be sufficiently improved.

Preferably, the types of the image samples and the type of the image to be evaluated are the text images.

25 FIG. 14 shows a schematic structural diagram of an image quality evaluating model generating module of an image quality evaluating system according to another embodiment of the present invention. As shown in FIG. 14, in the embodiment of the present invention, the image quality evaluating model generating module 100 includes:

a labeling unit 110 configured to label reference quality index values of image
30 samples;

a neural network structure generating unit 120 configured to generate a neural network structure according to the image samples; and

an iterative training unit 130 configured to perform an iterative training operation, by

using the image samples, on hierarchical parameters of the neural network structure to generate an image quality evaluating model.

It may be understood that, the neural network structure is a network structure for assisting subsequent machine learning, including an input layer, an output layer and a middle layer.

Preferably, the neural network structure refers to a convolutional neural network structure.

Preferably, the neural network structure refers to a network structure including a Convolution layer, an Activation layer and a Loss layer. The Convolution layer is configured to perform a feature extracting operation on the image sample. The Activation layer is configured to introduce a nonlinear factor. The Loss layer is configured to determine whether or not to continue an iterative training operation according to a difference between an evaluation result and the reference quality index value during a training process.

Preferably, the Activation layer includes a ReLU layer and a Sigmoid layer.

More preferably, the neural network structure further includes a Pooling layer, a Dropout layer and a SPP layer. The Pooling layer is configured to perform feature compression to simplify computational complexity and reduce over-fitting. The Dropout layer is configured to reduce the over-fitting. The SPP layer is configured to convert the extracted feature into a fixed size feature vector.

Preferably, hierarchical parameters of the Convolution layer include the number of convolution kernels, a size of the convolution kernel, a sliding step size of a convolution window, and a padding edge pixel value.

Preferably, hierarchical parameters of the Pooling layer include a sampling rule, a size of a sampling window, and a sliding step size of the sampling window.

Preferably, a hierarchical parameter of the Dropout layer includes a dropout rate.

Preferably, hierarchical parameters of the SPP layer include a sampling rule and the number of pyramid layers.

In another embodiment of the present invention, the iterative training unit 130 is further configured to input the image samples into the neural network structure according to training parameters, and calculate difference between output results of the Loss layer in the neural network structure and the reference quality index values, and update the hierarchical parameters of the neural network structure by using the difference, and

iteratively recalculate the difference according to the updated neural network structure, and generate the image quality evaluating model according to the neural network structure when the difference which is iteratively calculated reaches a preset threshold.

It may be understood that in the image quality evaluating system shown in FIG. 13 and FIG. 14, operations and functions of the image quality evaluating model generating module 100, the evaluating module 200, the labeling unit 110, the neural network structure generating unit 120, and the iterative training unit 130 may refer to the image quality evaluating method shown in FIGS. 1, 2 and 5. It will not be described redundantly herein so as to avoid redundancy.

FIG. 15 shows a schematic structural diagram of a text image quality evaluating equipment according to still another embodiment of the present invention. As shown in FIG. 15, the text image quality evaluating equipment 8 according to the embodiment of the present invention includes:

a text image obtaining module 81 configured to obtain a text image to be evaluated;

and

an evaluating module 82 configured to input the text image to be evaluated into a pre-trained text image quality evaluating model, and determine a quality index value of the text image to be evaluated according to an output value of the text image quality evaluating model. The quality index value refers to a floating point number.

Further, the text image quality evaluating equipment 8 further includes:

a text image sample obtaining module 83 configured to obtain text image samples for training;

a quality index value labeling module 84 configured to label a quality index value for each of the text image samples;

a text quality network setting module 85 configured to set a text quality network of a text image quality evaluating model;

a text image quality evaluating model obtaining module 86 configured to perform an iterative training operation on parameters of an initial text image quality assessment model, by using the text quality network according to the text image samples and the labeled quality index values, to obtain the text image quality evaluating model.

Further, the text quality network setting module 85 includes:

a text quality network structure setting sub-module 851 configured to set a text quality network structure, and the text quality network structure including five

Convolution layers, four ReLU layers, three Pooling layers, one Dropout layer, one SPP layer, one Sigmoid layer, and one Loss layer, and

an order of the text quality network structure being Convolution / ReLU / Pooling / Convolution / ReLU / Pooling / Convolution / ReLU / Pooling / Convolution / ReLU / Dropout / Convolution / SPP / Sigmoid / Loss; and

a hierarchical structure parameter setting sub-module 852 configured to set hierarchical parameters of the Convolution layers, the Pooling layers, the Dropout layer and the SPP layer in the text quality network structure.

Further, the hierarchical parameters of each of the setting Convolution layers include the number of convolution kernels, a size of the convolution kernel, a sliding step size of a convolution window, and a padding edge pixel value. The hierarchical parameters of each of the Pooling layers include a sampling rule, a size of a sampling window, and a sliding step size of the sampling window. The hierarchical parameter of the Dropout layer includes a dropout rate. The hierarchical parameters of the SPP layer include a sampling rule and the number of pyramid layers.

Further, the text image quality evaluating model obtaining module 86 specifically includes:

a training parameter determining sub-module 861 configured to determine training parameters;

an inputting sub-module 862 configured to input the text image samples into the initial text image quality evaluating model according to the training parameters;

an output result obtaining sub-module 863 configured to obtain output results of processing the text image samples by using the Convolution layers, the ReLU layers, the Pooling layers, the Dropout layer, the SPP layer, and the Sigmoid layer of the text quality network;

a difference calculating sub-module 864 configured to calculate difference between the output results and the corresponding labeled quality index values in the Loss layer of the text quality network;

an iterative calculating module 865 configured to propagate the difference back to each layer of the text quality network structure to update network parameters of each layer, and iteratively calculate until the difference reaches a preset threshold; and

a text image quality evaluating model generating sub-module 866 configured to obtain a final text image quality evaluating model.

In the image quality evaluating equipment according to the embodiments of the present invention, by means of obtaining the text image to be evaluated, inputting the text image to be evaluated into the pre-trained text image quality evaluating model, and determining the quality index value of the text image to be evaluated according to the output value of the quality evaluating model, quality of the text image may be specifically evaluated according to the pre-trained text image quality evaluating model. Meanwhile, the evaluating process is simple and easy to operate, and may be used as a pre-processing operation before OCR to reduce computational consumption. Compared with an existing image quality evaluating method in the prior art, the image quality evaluating method according to the embodiments of the present invention can greatly reduce calculation complexity and calculation amount. Meanwhile, compared with the prior art, the image is not required to be pre-processed, therefore, the evaluating process is fast. In addition, since the text image quality evaluating model is trained to generate according to a neural network based on a deep learning, human vision can be simulated to evaluate the quality of the text image during the evaluating process. Parameters of the text image quality evaluating model are iteratively trained repeatedly. Therefore, more effective and accurate quality evaluation results may be achieved and evaluation efficiency may be improved by using the pre-trained text image quality evaluating model to evaluate the text image.

All of the above optional technical solutions may be used in any combination to form optional embodiments of the present invention. Specific combinations are not described herein again.

It may be understood that when the text image quality evaluating equipment mentioned in the above embodiments implements the image quality evaluating method, a division of the above function modules is illustrated by examples. In a practical application, the above functions may be assigned by different function modules according to a need. That is an internal structure of the equipment is divided into different function modules to complete all or part of the functions described above. In addition, the text image quality evaluating equipment and the text image quality evaluating method according to the above embodiments belong to a same concept. A specific implementing process is described in detail in the method embodiments, and details are not described herein again.

As for those skilled in the art, it may be understood that all or part of the steps of the above embodiments may be implemented by using a hardware, or by instructing a

relevant hardware by using a program. The program may be stored in a computer readable storage medium, such as a Read Only Memory (ROM), a disk or a Compact Disc Read Only Memory (CD-ROM).

FIG. 16 shows a schematic structural diagram of an electronic equipment according to an embodiment of the present invention. As shown in FIG. 16, the electronic equipment includes a processor 161, a memory 162 and a bus 163.

The processor 161 is configured to call a code stored in the memory 162 through the bus 163 to generate an image quality evaluating model by using image samples, and perform an evaluating operation on the image to be evaluated by using the image quality evaluating model.

It may be understood that the electronic equipment includes, but is not limited to, an electronic equipment such as a mobile phone, a tablet computer and so on.

In an embodiment of the present invention, a computer readable storage medium is further provided. An image quality evaluating program is stored in the computer readable storage medium. When the image quality evaluating program is executed by a processor, operations of the image quality evaluating method mentioned in any one of the above embodiments is implemented.

It may be understood that the computer readable storage medium refers to a memory such as a CD-ROM, a floppy disk, a hard disk, a Digital Versatile Disc (DVD), a blue-ray disc and so on. Alternatively, some or all operations of the image quality evaluating method mentioned in the above embodiments may be implemented according to any combination of an Application Specific Integrated Circuit (ASIC), a Programmable Logic Device (PLD), an Erasable Programmable Logic Device (EPLD), a discrete logic, a hardware, a firmware and so on. In addition, although the flowcharts shown in the above embodiments describe the image quality evaluating method, operations in the image quality evaluating method may be modified, deleted or merged.

As described above, the image quality evaluating method mentioned in any one of the above embodiments may be implemented according to a coded instruction (such as a computer readable instruction). The coded instruction is stored on a tangible computer readable storage medium such as a hard disk, a flash memory, a ROM, a Compact Disc (CD), a DVD, a cache, a Random Access Memory (RAM), and/or any other storage mediums. In the tangible computer readable storage medium, information may be stored for any time (such as long time, permanence, transience, temporary buffering, and/or

caching of information). As used herein, the term of tangible computer readable storage medium is expressly defined to include any type of computer readable storage signals. Additionally or alternatively, the exemplary process of the image quality evaluating method mentioned in the above-described embodiments may be implemented according to the coded instruction (such as the computer readable instruction) stored on a non-transitory computer readable storage medium such as a hard disk, a flash memory, a ROM, a CD, a DVD, a cache, a RAM and/or any other storage mediums. In the non-transitory computer readable storage medium, information may be stored for any time (such as long time, permanence, transience, temporary buffering, and/or caching of information).

The above embodiments are only preferred embodiments of the present invention, and are not intended to limit the scope of the present invention. Any modification, equivalent, improvements, etc. made within the spirit and principles of the present invention may be included within the protection scope of the present invention.

What is claimed is:

1. An image quality evaluating method, comprising:
generating an image quality evaluating model by using image samples; and
performing an evaluating operation on an image to be evaluated by using the image
5 quality evaluating model.
2. The image quality evaluating method of claim 1, wherein the generating an image
quality evaluating model by using image samples comprises:
labeling reference quality index values of the image samples;
generating a neural network structure according to the image samples; and
10 performing an iterative training operation, by using the image samples, on
hierarchical parameters of the neural network structure to generate the image quality
evaluating model.
3. The image quality evaluating method of claim 2, wherein the performing an
iterative training operation, by using the image samples, on hierarchical parameters of the
15 neural network structure to generate the image quality evaluating model comprises:
inputting the image samples into the neural network structure according to training
parameters;
calculating difference between output results of a Loss layer in the neural network
structure and the reference quality index values;
20 updating the hierarchical parameters of the neural network structure by using the
difference, and iteratively recalculating the difference according to the updated neural
network structure; and
generating the image quality evaluating model according to the neural network
structure when the difference which is iteratively calculated reaches a preset threshold.
- 25 4. The image quality evaluating method of claim 3, wherein the training parameters
comprise at least one of a total number of iterations, the sample number of per iteration, a
test interval, a learning rate, a weight of each layer of an initialed neural network structure,
a bias term, and learning rates of the bias term and the weight of each layer of the
initialed neural network structure.
- 30 5. The image quality evaluating method of any one of claims 2 to 4, wherein the
neural network structure comprises a Convolution layer, an Activation layer and a Loss
layer.
6. The image quality evaluating method of claim 5, wherein the Activation layer

comprises a ReLU layer and a Sigmoid layer.

7. The image quality evaluating method of claim 6, wherein a hierarchical order in the neural network structure is the Convolution layer, the ReLU layer, the Convolution layer, the ReLU layer, the Convolution layer, the ReLU layer, the Sigmoid layer and the Loss layer.

8. The image quality evaluating method of claim 6, wherein the neural network structure further comprises a Pooling layer, a Dropout layer and a SPP layer.

9. The image quality evaluating method of claim 8, wherein a hierarchical order in the neural network structure is the Convolution layer, the ReLU layer, the Pooling layer, the Convolution layer, the ReLU layer, the Pooling layer, the Convolution layer, the ReLU layer, the Pooling layer, the Convolution layer, the ReLU layer, the Dropout layer, the Convolution layer, the SPP layer, the Sigmoid layer and the Loss layer.

10. The image quality evaluating method of any one of claims 5 to 9, wherein hierarchical parameters of the Convolution layer comprise the number of convolution kernels, a size of the convolution kernel, a sliding step size of a convolution window, and a padding edge pixel value.

11. The image quality evaluating method of claim 8 or 9, wherein hierarchical parameters of the Pooling layer comprise a sampling rule, a size of a sampling window, and a sliding step size of the sampling window.

12. The image quality evaluating method of claim 8 or 9, wherein a hierarchical parameter of the Dropout layer comprises a dropout rate.

13. The image quality evaluating method of claim 8 or 9, wherein hierarchical parameters of the SPP layer comprise a sampling rule and the number of pyramid layers.

14. An image quality evaluating system, comprising an image quality evaluating model generating module configured to generate an image quality evaluating model by using image samples; and

an evaluating model configured to perform an evaluating operation on an image to be evaluated by using the image quality evaluating model.

15. The image quality evaluating system of claim 14, wherein the image quality evaluating model generating module comprises:

a labeling unit configured to label reference quality index values of the image samples;

a neural network structure generating unit configured to generate a neural network

structure according to the image samples; and

an iterative training unit configured to perform an iterative training operation, by using the image samples, on hierarchical parameters of the neural network structure to generate the image quality evaluating model.

5 16. The image quality evaluating system of claim 15, wherein the iterative training unit is further configured to input the image samples into the neural network structure according to training parameters, and calculate difference between output results of a Loss layer in the neural network structure and the reference quality index values, and update the hierarchical parameters of the neural network structure by using the difference,
10 and iteratively recalculate the difference according to the updated neural network structure, and generate the image quality evaluating model according to the neural network structure when the difference which is iteratively calculated reaches a preset threshold.

15 17. The image quality evaluating system of claim 16, wherein the training parameters comprise at least one of a total number of iterations, the sample number of per iteration, a test interval, a learning rate, a weight of each layer of an initialed neural network structure, a bias term, and learning rates of the bias term and the weight of each layer of the initialed neural network structure.

20 18. The image quality evaluating system of any one of claims 15 to 17, wherein the neural network structure comprises a Convolution layer, an Activation layer and a Loss layer.

19. The image quality evaluating system of claim 18, wherein the Activation layer comprises a ReLU layer and a Sigmoid layer.

25 20. The image quality evaluating system of claim 19, wherein a hierarchical order in the neural network structure is the Convolution layer, the ReLU layer, the Convolution layer, the ReLU layer, the Convolution layer, the ReLU layer, the Sigmoid layer and the Loss layer.

21. The image quality evaluating system of claim 19, wherein the neural network structure further comprises a Pooling layer, a Dropout layer and a SPP layer.

30 22. The image quality evaluating system of claim 21, wherein a hierarchical order in the neural network structure is the Convolution layer, the ReLU layer, the Pooling layer, the Convolution layer, the ReLU layer, the Pooling layer, the Convolution layer, the ReLU layer, the Pooling layer, the Convolution layer, the ReLU layer, the Dropout layer,

the Convolution layer, the SPP layer, the Sigmoid layer and the Loss layer.

23. The image quality evaluating system of any one of claims 18 to 22, wherein hierarchical parameters of the Convolution layer comprise the number of convolution kernels, a size of the convolution kernel, a sliding step size of a convolution window, and
5 a padding edge pixel value.

24. The image quality evaluating system of claim 21 or 22, wherein hierarchical parameters of the Pooling layer comprise a sampling rule, a size of a sampling window, and a sliding step size of the sampling window.

25. The image quality evaluating system of claim 21 or 22, wherein a hierarchical
10 parameter of the Dropout layer comprises a dropout rate.

26. The image quality evaluating system of claim 21 or 22, wherein hierarchical parameters of the SPP layer comprise a sampling rule and the number of pyramid layers.

27. A computer readable storage medium storing an image quality evaluating program for executing a processor to execute the image quality evaluating method
15 according to any one of claims 1 to 13.