TARGET CELL LABELING METHOD, APPARATUS, COMPUTER READABLE MEDIUM, AND DEVICE THEREOF

CROSS-REFERENCE TO RELATED APPLICATION

The present application claims priority to Chinese Patent Application No. 201910066278.1 entitled "TARGET CELL LABELING METHOD, APPARATUS, COMPUTER READABLE MEDIUM, AND DEVICE THEREOF" filed on January 24, 2019, the contents of which is expressly incorporated by reference herein in its entirety.

TECHNICAL FIELD

The present disclosure relates the field of image processing, and specially relates to a target cell labeling method, an apparatus, a computer readable medium, and a device thereof.

BACKGROUND

Target cell detecting and labeling are acted major roles in a biologic field and a medical field, which can assist a relative person for analyzing and researching the cells. Traditional cell detecting and labeling are achieved by manually segmenting a cell cytoplasm or a cell nucleus of the cell or by an image processing arithmetic based on a simple feature extraction.

The method of detecting and labeling the target cells through segmenting the cell cytoplasm or the cell nucleus of the cell are complex and time consuming, and is relied on a subjective judgement of a reader. The image processing arithmetic based on the simple feature extraction only can process an image with a smaller size in specified image format for detecting and labeling the target cells. There is a limitation in image format, and the target cells may be missed or be incomplete, thus

a comprehensive of the target cell detecting and labeling is hard to achieved, and an accuracy and a reliability of the target cell detecting and labeling are reduced.

TECHNICAL PROBLEM

The present disclosure provides a target cell labeling method based on images, an apparatus, a computer readable medium, and a device, which can automatically detect and label the target cell in a bigger image with different formats, the omitted target cells in the bigger image are reduced, a comprehensive of the detected and labeled target cell is improved, the detection result is visual, a relying on subjective experience of the reader is reduced, an accuracy and a reliability of the target cell detecting and labeling are improved.

TECHNICAL SOLUATION

The present disclosure firstly provides a target cell labeling method based on images, the target cell labeling method including:

Acquiring an original scanned image, confirming an original image format of the original scanned image, and converting the original scanned image into a first image with a preset image format;

Segmenting the first image into image titles based on a preset segment manner, and recording arrangement position of each image title in the first image;

Inputting each image title into a preset deep learning detection model respectively, and acquiring first position information of target cells in each image title outputted by the deep learning detection model;

Confirming second position information of each target cell in the first image based on the first position information and the corresponding arrangement position;

Integrating the image titles based on the arrangement position, and labeling the target cells in an integrated second image based on the arrangement position;

Converting the second image with the labeled target cells into a third image with the original image format, and displaying the third image.

The present disclosure secondly provides a target cell labeling apparatus based on images, the target cell labeling apparatus including:

A format conversion module, configured to acquire an original scanned image, confirm an original image format of the original scanned image, and convert the original scanned image into a first image with the original image format;

A image segmentation module, configured to segment the first image into image titles based on a preset segment manner, and record arrangement position of each image title in the first image;

A target cell detection module, configured to input each image title into a preset deep learning detection model respectively, and obtain first position information of target cells in each image title outputted by the deep learning detection model;

A position information confirming module, configured to confirm second position information of each target cell in the first image based on the first position information and the corresponding arrangement position;

A target cell labeling module, configured to integrate the image titles based on the arrangement position to obtain a second image, and label the target cells in a second image obtained by integrating the image based on the arrangement position;

A target cell display module, configured to convert the second image with the labeled target cells into a third image with the original image format, and display the third image.

The present disclosure thirdly provides a computer readable medium with computer readable instructions stored thereon, when the computer readable programs are executed by a processor, the following steps as recited in the target cell labeling method based on images are implemented.

The present disclosure fourthly provides a device, the device includes a storage medium, a processor, and computer readable instructions stored in the storage medium, the processor executes the computer readable instructions to implement the following steps:

Acquiring an original scanned image, confirming an original image format of the original scanned image, and converting the original scanned image into a first image with a preset image format;

Segmenting the first image into image titles based on a preset segment manner, and recording arrangement position of each image title in the first image;

Inputting each image title into a preset deep learning detection model respectively, and acquiring first position information of target cells in each image title outputted by the deep learning detection model;

Confirming second position information of each target cell in the first image based on the first position information and the corresponding arrangement position;

Integrating the image titles based on the arrangement position to obtain a second image, and labeling the target cells in a second image obtained by integrating the image based on the arrangement position;

Converting the second image with the labeled target cells into a third image with the original image format, and displaying the third image.

BENEFICIAL EFFECT

In the present disclosure, the target cells in the bigger image can be automatically detected by using format converting, image segmenting, and the deep learning detection model, and automatically labeled the target cells based on the detected position information and the arrangement position while segmenting, the number of the omitted target cells in the bigger image are reduced, a comprehensive of the detected and labeled target cell is improved, besides the detection result is visual by restoring the format of the label result, a relying on subjective experience of the reader is reduced, the reader can understand the label situation quickly.

BRIEF DESCRIPTION OF THE FIGURES

Implementations of the present disclosure will now be described, by way of example only, with reference to the attached figures, wherein:

FIG. 1 is a flowchart of an embodiment of a target cell labeling method based on images;

FIG. 2 is a flowchart of an embodiment of acquiring the first position information of the target cell of the target cell labeling method under an application scenario;

FIG. 3 is a flowchart of an embodiment of training the deep learning detection model of the target cell labeling method under an application scenario;

FIG. 4 is a flowchart of an embodiment of displaying the labeled result of the target cell labeling method under an application scenario;

FIG. 5 is a diagram view of an embodiment of a target cell labeling apparatus based on images; and

FIG. 6 is a diagram view of an embodiment of a device.

DETAILED DESCRIPTION

In order to making the technical problems, the technical solutions, and beneficial effects to be more clearer and more understand, the present disclosure is further described in detail with reference to the accompanying drawings and the embodiments. It will be understood that the specific embodiments described herein are merely used for describing the present disclosure, but are not intended to limit the present disclosure.

It needs to be explained that the descriptions related to “first”, “second” and so on in the present disclosure are only description purpose, but are not being understood as indicating or implying a relative significance of itself or implying an amount of the indicated technical feature. Thus, the features limited with “first” or “second” are indicated or implied including at least one feature. Besides, the technical solutions between different embodiments can be mutual combination, but only based on being achieved by those of an ordinary skill in the art, it should be recognized that the technical solution is not existed when the combination of the technical solutions being mutual contradiction or being unable to be achieved, and it is also not within the protecting range of the present disclosure.

Referring to FIG. 1, the present disclosure provides a target cell labeling method. The target cell labeling method including:

Step S101, acquiring an original scanned image, confirming an original image format of the original scanned image, and converting the original scanned image into a first image with a preset image format.

In one embodiment, the original image format can be a format, such as ".svs", ".kfb", ".ndpi", or ".tif", and so on. The original scanned image can be a full scan image. A size of the original scanned image can be 2G. The pixels in the original scanned image can be 100000x100000. The preset image format can be an image format, which is convenience to the computer for image analyzing and processing, such as ".jpg", ".png", and so on, thus a speed and an efficient of the analyzing and processing operations in the computer are improved. In that means, in the one embodiment, the original scanned image can be different formats scanned by different scanner, such as when the full scanned TCT image are obtained, the format of which is inconvenience to the computer for analyzing and processing, the original scanned image can be converted into the first image with the preset image format, such as a format of ".jpg", or ".png", which is convenience to the computer for image analyzing and processing.

Step S102, segmenting the first image into image titles based on a preset segment manner, and recording arrangement position of each image title in the first image.

In one embodiment, the after acquiring the first image by converting the format of the original scanned image, the first image is firstly segmented in the preset segment manner, for example, the first image is segmented in a tiled segment manner for segmenting the first image into image titles with a preset size, for example, the preset size can be 1024*1024, the arrangement position of each image title in the first

image are recorded, for example, each image title is named by an arrangement sequence of each image title for recording the arrangement position of each image title in the first image.

Preferably, in one embodiment, the step of segmenting the first image into the image titles based on the preset segment manner includes:

Step a, acquiring a distribution of the target cells and a size of the first image, Step b, segmenting the first image into the image titles with the preset size based on the distribution of the target cells and the size of the first image.

In one embodiment, as the recited of Step a and Step b, when segmenting the first image, the distribution of the target cells and the size of the first image are obtained, and the size of each image title and a segment position are confirmed based on the distribution of the target cells and the size of the first image, the first image is segmented based on the confirmed size of each image title and the segment position, thus the first image is segmented into the image titles with the preset size. The preset size is the confirmed size of each image title.

Step S103, inputting each image title into a preset deep learning detection model respectively, and acquiring first position information of target cells in each image title outputted by the deep learning detection model.

It is understandable that, after the image titles are obtained, each image title is inputted into the preset deep learning detection model, and the first position information of target cells in each image title are detected by the deep learning detection model. In one embodiment, before inputting each image title into the preset deep learning detection model, the image title can be optimization processed, for example, a manner for increasing an identification of the image through

denoising, sharpening, increasing contrast, and so on, an accuracy of the deep learning detection model is improved.

Further, as shown in FIG. 2, the step of inputting each image title into a preset deep learning detection model respectively, and acquiring first position information of target cells in each image title outputted by the deep learning detection model further includes:

Step S201, inputting each image title into a preset classified model, and acquiring a classified result outputted by the preset classified model.

Step S202, confirming a classified group satisfied with a first preset condition in the classified result.

Step S203, inputting the image titles corresponding to the classified group into the preset deep learning detection model, and acquiring the first position information of each target cell in the image titles outputted by the deep learning detection model.

As the recited of Step S201 to Step S203, it is understandable that the classified model can be obtained by training a convolutional neural network. The classified model is used for initially judging the target cells in the image title. In other words, the classified model determines that whether there is target cell in each image title, for confirming the image title with the target cells, the confirmed image titles are respectively inputted into the deep learning detection model. The deep learning detection model further accurately detects and locates the target cells in the confirmed image titles, the number of the inputted image titles are reduced by the initially judging, and a processing burden of the deep learning detection model is

reduced, thus a detection speed and a detection efficiency in the target cells detection are improved.

Preferably, as shown in FIG. 3, in one application scenario, the deep learning detection model can be obtained by training as the following steps.

Step S301, selecting a preset number of sample image titles.

Step S302, labeling standard position information of each target cell in each sample image title based on the distribution of the target cells in each sample image title.

Step S303, inputting each sample image title into an initial preset deep learning detection model, and acquiring trained position information of the target cells in each sample image title outputted by the initial deep learning detection model.

Step S304, calculating a first error between the trained position information and the corresponding standard position information.

Step S305, determining whether the first error meets a second preset condition.

Step S306, confirming the training operation of the deep learning detection model to be completed when the first error meets the second preset condition.

Step S307, adjusting model parameters of the deep learning model and using the deep learning detection model with the adjusted model parameters as the initial deep learning detection model when the first error does not meet the second preset condition.

As the recited step S301, before training the deep learning detection model, training samples for training needs to be obtained in advance, in other words, the

preset number of the sample image titles needs to be obtained in advance. The sample image titles can be the image titles with the target cells or the image titles without the target cells. It is understandable that, the more training samples, the better training effect of the deep learning detection model is achieved. Thus, the training samples needs to be obtained as many as possible.

As the recited step S302, after the training sample image titles are acquired, the standard position information of each target cell in each sample image title is labeled based on the distribution of the target cells, such as the target cells in each sample image title are selected by a box.

As the recited step S303, after the standard position information of each target cell in each sample image title is labeled, the sample titles are inputted into the initial deep learning detection model for achieving the trained position information of the target cells in each sample image title. The training of the deep learning detection model is not completed, thus there are errors between the outputted trained position information and the corresponding standard position information.

As the recited step S304 and step S305, after the trained position information is acquired, a first error between the trained position information and the corresponding standard position information is calculated, and whether the first error meets the second preset condition is determined. For example, whether the first error is less than 5% is determined. Therefore, the second preset condition can be set while training the deep learning detection model. For example, the second condition is that the first error is less than a specified threshold value, the specified threshold value can be a percent value. The smaller the specified threshold value is, the more

stable of the trained deep learning detection model being trained will be, and the more identification accuracy will be.

As the recited step S306, it is understandable that, when the first error between the trained position information and the corresponding standard position information meets the second preset condition, such as, the first error between the trained position information and the corresponding standard position information is less than 5%, the training of the deep learning detection model is completed.

As the recited step S307, when the first error between the trained position information and the corresponding standard position information does not meet the second preset condition, such as, when the first error between the trained position information and the corresponding standard position information is 10%, the model parameters of the deep learning detection model adjusts, and the deep learning detection model with the adjusted model parameters are severed as the initial deep learning detection model, the sample image titles are re-trained. By repeatedly adjusting the model parameters of the deep learning detection model, and training the sample image titles for several times, the first error between the trained position information and the corresponding standard position information is minimized, and until the error between the trained position information and the corresponding standard position information meets the second preset condition.

Further, in another application scenario, the deep learning detection model is trained by the following steps: Step c, selecting a preset number of sample image titles; Step d, labeling standard position information and a standard cell type of each target cell in each sample image title based on the distribution of the target cells in each sample image title; Step e, inputting each sample image title into an initial

preset deep learning detection model, and acquiring trained position information and a trained cell type of the target cells in each sample image title outputted by the initial deep learning detection model; Step f, calculating a second error between the trained position information and the corresponding standard position information, and calculating a third error between the trained cell type and the corresponding standard cell type; Step g, adjusting model parameters of the deep learning model and using the deep learning detection model with the adjusted model parameters as the initial deep learning detection model when the second error does not meet a third preset condition or the third error does not meet a fourth preset condition, and the procedure executes the step of inputting the sample image titles into the initial deep learning detection model and the following steps; Step h, confirming the deep learning detection model to be completed when the second error meets the fourth preset condition and the third error meets the fourth preset condition.

It is understandable that, the difference between the current application scenario and the above recited application scenario is that a training of cell type of each target cell is added in the current application scenario. In the current application scenario, while training of the deep learning detection model, the cell type of each target cell in each sample image title can be labeled for identifying and training the labeled cell type in the sample image titles, which are used for training the deep learning detection model. The trained deep learning detection model can be further trained for detecting the cell types of the target cells in each image title.

It needs to be noted that, when the detected target cell is abnormal cell, the training of the deep learning detection model can further increase a training of abnormal types of the abnormal cells and a training of abnormal levels of the

abnormal cells, thus the trained deep learning detection model can detect the position information and the cell type of the abnormal cell in each image title, and further can detect abnormal type and the abnormal level of the abnormal cell. The identifying and training manner of the cell types, the abnormal types, and the abnormal levels are same, it will not repeat again.

Step S104, confirming second position information of each target cell in the first image based on the first position and the corresponding arrangement position.

It is understandable that, the first position information is position information of each target cell in corresponding image title. For labeling a specific position of each target cell in the original scanned image, the position information of each target cell in the first image needs to be confirmed. Therefore, in the embodiment, after the first position information of each target cell in corresponding image title is acquired, the second position information of each target cell in the corresponding image title can be confirmed based on the first position information and the corresponding arrangement position, in other words, the specific position information in the first image of each target cell in the corresponding image title is confirmed.

Step S105, integrating the image titles based on the arrangement position, and labeling the target cells in an integrated second image based on the arrangement position.

It is understandable that, after the position information of each target cell in corresponding image title is confirmed, in other words, the second position information is confirmed, all the image titles can be integrated based on the arrangement position of the image titles in the first image, thus the second image is

acquired by the integrating operation. Each target cell is labeled based on the second position information. The second image can be the same as the first

Step 106, converting the second image with the labeled target cells into a third image with the original image format, and displaying the third image.

In one embodiment, the integrated second image is the same as the first image, and the image format of the second image is the same as the image format of the first image. To facilitate the reading for related readers, the image with the labeled target cell can be read by common reading software, and the labeled second image can be converted into the third image with the original image format. The third image can be displayed on the common reading software, for visually displaying the labeling result of the target cells in the original scanned image, the subjective dependence on the readers is reduced, and it is convenient for the readers to view.

In one embodiment, the labeled second image can also be converted into the third image with other image formats to be displayed. The image format of the third image can be set based on a requirement of the reading software used by the related person.

Preferably, as shown in FIG. 4, in the embodiment, the step of displaying the third image can include the following steps. Step S401, acquiring cell type of each target cell in the third image; step S402, confirming a display icon and/or a display color of each target cell based on a preset relation; and step S403, displaying the target cells with the display icon and/or the display color in the third image based on the cell type.

As the recited steps S401-S403, it is understandable, in the embodiment, the display icon and/or the display color of each cell type can be preset to one cell type, in other words, a relationship between the cell type and the display icon and/or the display color is preset. Therefore, after the cell type outputted by the deep learning detection model is acquired, the display icon and/or the display color of each cell type can be confirmed based on the preset relation, and the third image is displayed. By displaying the corresponding display icon and/or the corresponding display color of each cell type of each target cell, it is more convenience to the related reader for intuitively understanding a specific situation of each target cell.

In one embodiment, by using format converting, image segmenting, and the deep learning detection model, the target cell in a bigger image with different image formats can be automatically detect, and automatically labeled based on the detected position information and the arrangement position while segmenting, the number of the omitted detected and labeled target cells in the bigger image are reduced, a comprehensive of the detected and labeled target cell is improved, and an accuracy and a reliability of target cell detecting and labeling is improved. Besides, the labeled result is restored for visual displaying, the subjective dependence on the readers is reduced, and it is more convenient to the related reader for intuitively understanding a specific situation of each target cell.

It is understandable that, a logic sequence shown in the flowchart does not mean an executed sequence, the executed sequence of the procedure should be confirmed by a corresponding function and an internal logic, and is not intended to limit the protection scope of the present disclosure.

The foregoing description is the target cell labeling method based on images, a target cell labeling apparatus will describe as below. The target cell labeling apparatus includes:

As shown in FIG. 5, the present disclosure provides a target cell labeling apparatus based on images. The target cell labeling apparatus includes:

A format conversion module 501, configured to acquire an original scanned image, confirm an original image format of the original scanned image, and convert the original scanned image into a first image with a preset image format.

An image segmentation module 502, configured to segment the first image into image titles based on a preset segment manner, and record arrangement position of each image title in the first image.

A target cell detection module 503, configured to input each image title into a preset deep learning detection model respectively, and obtain first position information of target cells in each image title outputted by the deep learning detection model.

A position information confirming module 504, configured to confirm second position information of each target cell in the first image based on the first position information and the corresponding arrangement position.

A target cell labeling module 505, configured to integrate the image titles based on the arrangement position, and label the target cells in an integrated second image based on the arrangement position.

A target cell display module 506, configured to convert the second image with the labeled target cells into a third image with the original image format, and display the third image.

Further, the target cell detection module 503 further includes:

An image title classification unit, configured to input each image title into a preset classified model, and obtain a classified result outputted by the preset classified model.

A classification confirming unit, configured to confirm a classified group satisfied with a first preset condition in the classified result.

A target cell detection module, configured to input the image titles corresponding to the classified group into the preset deep learning detection model, and obtain the first position information of each target cell in the image titles outputted by the deep learning detection model.

The image segmentation module 502 can include:

A first sample image title selection module, configured to select a preset number of sample image titles.

A first image title labeling module, configured to label standard position information of each target cell in each sample image title based on the target cells in each sample image title.

Optionally, the target cell labeling apparatus also can include:

A first trained position information acquiring module, configured to input each sample image title into an initial preset deep learning detection model, and acquire trained position information of the target cells in each sample image title outputted by the initial deep learning detection model.

A first error calculating module, configured to calculate a first error between the trained position information and the corresponding standard position information.

A first model parameter adjustment module, configured to adjust model parameters of the deep learning model and use the deep learning detection model with the adjusted model parameters as the initial deep learning detection model when the first error does not meet a second preset condition.

A first training completing module, configured to confirm the training operation of the deep learning detection model being completed when the first error meets the second preset condition.

Further, the target cell labeling apparatus can further include:

A second sample image title selection module, configured to select a preset number of sample image titles.

A second sample image title labeling module, configured to label standard position information and a standard cell type of each target cell in each sample image title based on the target cells in each sample image title.

A second trained result acquiring module, configured to input each sample image title into an initial preset deep learning detection model, and acquire trained position information and a trained cell type of the target cells in each sample image title outputted by the initial deep learning detection model.

A second error calculating module, configured to calculate a first error between the trained position information and the corresponding standard position information, and calculate a third error between the trained cell type and the corresponding standard cell type.

A second model parameter adjustment module, configured to adjust model parameters of the deep learning model and use the deep learning detection model with the adjusted model parameters as the initial deep learning detection model when

the second error does not meet a third preset condition or the third error does not meet a fourth preset condition.

A second training completing module, configured to confirm the training operation of the deep learning detection model being completed when the second error meets the third preset condition, and the third error meets the fourth preset condition.

Preferably, the target cell display module 506 can include:

A cell type acquiring module, configured to acquire cell type of each target cell in the third image.

An icon color confirming unit, configured to confirm a display icon and/or a display color corresponding to each type of the target cell based on a preset relation.

A target cell display unit, configured to display the target cells with the display icon and/or the display color in the third image based on the cell type.

FIG. 6 is an embodiment of a device. As shown in FIG. 6, the device 6 in the embodiment includes a processor 60, a storage medium 61, and computer readable instructions 62 stored in the storage medium 61 and being executed by the processor 60, for example, the computer readable instructions 62 are target cell labeling programs based on images. The processor 60 executes the computer readable instructions 62 to implement the steps of the above recited target cell labeling method based on images, for example the steps S101-S106 as shown in FIG. 1. Or, the processor 60 executes the computer readable instructions 62 to implement the modules/units of the above recited embodiments, for example the modules 501-506 as shown in FIG. 5.

Exemplary, the computer readable instructions 62 are divided into one or more modules or units. The one or more modules or units are stored in the storage medium 61, and are executed by the processor 60 to achieve the application. The one or more modules or units can be a series of computer readable instruction segments capable of achieving specified functions, which describe a process of the computer readable instruction 62 being executed in the device 6.

The device 6 can be computer device, such as a desktop computer, a notebook, a palmtop computer, or a server, and so on. The device 6 can include the processor 60 and the storage medium 61, not being limited thereto. It is understandable to persons skilled in the art that the device 6 in FIG. 6 is merely an example, not being limited thereto. There can be more or less components in other embodiments, or some components being combined, or some different components, for example, the device 6 can further include an input/output device, a network access device, a data bus, and so on.

The processor 60 can be a central processing unit (CPU), and can be other general processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA), or other programmable logic device, a separate gate or transistor logic device, a separate hardware component, and so on. The general processor can be a micro processor, or other regular data processing chips, and so on.

The storage medium 61 can be an internal storage unit of the device 6, such as a hard disk or a memory in the device 6. The storage medium 11 can be an external storage device of the device 6, such as a plug-in hard disk in the electronic apparatus 1, a smart media card (SMC), a secure digital (SD), a flash card, and so on.

Further, the storage medium 61 can includes the internal storage unit and the external storage device of the device 6. The storage medium 61 stores the computer readable instructions 62, other programs, and data of the device 6. The storage medium 61 also can provisionally store the data being outputted or to-be outputted.

Besides, the different function units in the embodiment can be embedded in one processor unit, each unit can be a single physical presence, or be formed by two or more units embedded in one unit. The embedded unit can be achieved by hardware manner or by software manner.

It will be understandable to a person skilled in the art that a part or the whole process in the foregoing method according to the above-mentioned embodiments can be implemented by hardware related to the computer readable instructions. The computer readable instructions can stores in a computer non-volatile readable storage medium. While executing the computer readable instructions, the computer readable instructions include the procedure of the above recited method. The quoted storage medium, storing operation, database, or other medium used in each embodiment, can include a non-volatile memory and/or a volatile memory. The non-volatile memory can include a read-only memory (ROM), a programmable read-only memory (PROM), an electrically programmable read-only memory (EPROM), an electrically erasable programmable read-only memory (EEPROM), or a flash. The volatile memory can include a read-access memory (RAM) or an external cache memory. For example, the RAM can be a static read-access memory (SRAM), a dynamic read-access memory (DRAM), a synchronous dynamic read-access memory (SDRAM), a double data rate synchronous dynamic read-access memory (DDRSDRAM), an enhanced synchronous dynamic read-access memory

(ESDRAM), a synchlink dynamic read-access memory (SLDRAM), a rambus dynamic read-access memory (RDRAM), a direct rambus dynamic read-access memory (DRDRAM), a rambus dynamic read-access memory (RDRAM), and so on.

As recited above, the foregoing implementations are merely specific embodiments of the present disclosure, and are not intended to limit the protection scope of the present disclosure. Even the foregoing implementations describes the detailed present disclosure, it is understandable to a person skilled in the art, any modifications or equivalent replacements of some feature of the above recited foregoing implementations, shall all fall within the spirit and patentable scope of the present disclosure.

CLAIMS

What is claimed is:

1. A target cell labeling method comprising:

acquiring an original scanned image, confirming an original image format of the original scanned image, and converting the original scanned image into a first image with a preset image format;

segmenting the first image into image titles based on a preset segment manner, and recording arrangement position of each image title in the first image;

inputting each image title into a preset deep learning detection model respectively, and acquiring first position information of target cells in each image title outputted by the deep learning detection model;

confirming second position information of each target cell in the first image based on the first position information and the corresponding arrangement position;

integrating the image titles based on the arrangement position, and labeling the target cells in an integrated second image based on the arrangement position; and

converting the second image with the labeled target cells into a third image with the original image format, and displaying the third image.

2. The target cell labeling method of claim 1, wherein the step of acquiring an original scanned image, confirming an original image format of the original scanned image, and converting the original scanned image into a first image with a preset image format further comprises:

inputting each image title into a preset classified model, and acquiring a classified result outputted by the preset classified model;

confirming a classified group satisfied with a first preset condition in the classified result; and

inputting the image titles corresponding to the classified group into the preset deep learning detection model, and acquiring the first position information of each target cell in the image titles outputted by the deep learning detection model.

3. The target cell labeling method of claim 1, wherein the step of segmenting the first image into image titles based on a preset segment manner, and recording arrangement position of each image title in the first image comprises:

acquiring a distribution of the target cells and a size of the first image; and

segmenting the first image into the image titles with the preset size based on the distribution of the target cells and the size of the first image.

4. The target cell labeling method of any one of claims 1-3, wherein the deep learning detection model is trained by the following steps:

selecting a preset number of sample image titles;

labeling standard position information of each target cell in each sample image title based on the distribution of the target cells in each sample image title;

inputting each sample image title into an initial preset deep learning detection model, and acquiring trained position information of the target cells in each sample image title outputted by the initial deep learning detection model;

calculating a first error between the trained position information and the corresponding standard position information;

adjusting model parameters of the deep learning model and using the deep learning detection model with the adjusted model parameters as the initial deep learning detection model when the first error does not meet a second preset condition; and

confirming the training operation of the deep learning detection model to be completed when the first error meets the second preset condition.

5. The target cell labeling method of any one of claims 1-3, wherein the deep learning detection model is trained by the following steps:

selecting a preset number of sample image titles;

labeling standard position information and standard cell type of each target cell in each sample image title based on the distribution of the target cells in each sample image title;

inputting each sample image title into an initial preset deep learning detection model, and acquiring trained position information and trained cell type of the target cells in each sample image title outputted by the initial deep learning detection model;

calculating a second error between the trained position information and the corresponding standard position information and a third error between the trained cell type and the corresponding standard cell type;

adjusting model parameters of the deep learning model and using the deep learning detection model with the adjusted model parameters as the initial deep learning detection model when the second error does not meet a third preset condition or the third error does not meet a fourth preset condition; and

confirming the training operation of the deep learning detection model to be completed when the second error meets the third preset condition and the third error meets the fourth preset condition.

6. The target cell labeling method of claim 5, wherein the step of inputting the image titles corresponding to the classified group into the preset deep learning detection model, and acquiring the first position information of each target cell in the image titles outputted by the deep learning detection model comprises:

acquiring cell type of each target cell in the third image;

confirming a display icon and/or a display color corresponding to each type of the target cell based on a preset relation; and

displaying the target cells with the display icon and/or the display color in the third image based on the cell type.

7. A target cell labeling apparatus comprising:

a format conversion module, configured to acquire an original scanned image, confirm an original image format of the original scanned image, and convert the original scanned image into a first image with a preset image format;

an image segmentation module, configured to segment the first image into image titles based on a preset segment manner, and record arrangement position of each image title in the first image;

a target cell detection module, configured to input each image title into a preset deep learning detection model respectively, and acquire first position information of target cells in each image title outputted by the deep learning detection model;

a position information confirming module, configured to confirm second position information of each target cell in the first image based on the first position information and the corresponding arrangement position;

a target cell labeling module, configured to integrate the image titles based on the arrangement position, and label the target cells in an integrated second image based on the arrangement position; and

a target cell display module, configured to convert the second image with the labeled target cells into a third image with the original image format, and display the third image.

8. The target cell labeling apparatus of claim 7, wherein the target cell detection module comprises:

an image title classification unit, configured to input each image title into a preset classified model, and acquire a classified result outputted by the preset classified model;

a classification confirming unit, configured to confirm a classified group satisfied with a first preset condition in the classified result; and

a target cell detection module, configured to input the image titles corresponding to the classified group into the preset deep learning detection model, and acquire the first position information of each target cell in the image titles outputted by the deep learning detection model.

9. The target cell labeling apparatus of claim 7, wherein the image segment module comprises:

an image information acquiring unit, configured to acquire a distribution of the target cells and a size of the first image; and

an image segment unit, configured to segment the first image into the image titles with the preset size based on the distribution of the target cells and the size of the first image.

10. The target cell labeling apparatus of any one of claims 7-9, wherein the target cell labeling module further comprises:

a first sample image title selection module, configured to select a preset number of sample image titles;

a first image title labeling module, configured to label standard position information of each target cell in each sample image title based on the distribution of the target cells in each sample image title;

a first trained position information acquiring module, configured to input each sample image title into an initial preset deep learning detection model, and acquire trained position information of the target cells in each sample image title outputted by the initial deep learning detection model;

a first error calculating module, configured to calculate a first error between the trained position information and the corresponding standard position information;

a first model parameter adjustment module, configured to adjust model parameters of the deep learning model and use the deep learning detection model with the adjusted model parameters as the initial deep learning detection model when the first error does not meet a second preset condition; and

a first training completing module, configured to confirm the training operation of the deep learning detection model being completed when the first error meets the second preset condition.

11. The target cell labeling apparatus of any one of claims 7-9, wherein the target cell labeling module further comprises:

a second sample image title selection module, configured to select a preset number of sample image titles;

a second sample title labeling module, configured to label standard position information and standard cell type of each target cell in each sample image title based on the distribution of the target cells in each sample image title;

a second trained result acquiring module, configured to input each sample image title into an initial preset deep learning detection model, and acquire trained position information and trained cell types of the target cells in each sample image title outputted by the initial deep learning detection model;

a second error calculating module, configured to calculate a second error between the trained position information and the corresponding standard position information, and a third error between the trained cell type and the standard cell type;

a second model parameter adjustment module, configured to adjust model parameters of the deep learning model and use the deep learning detection model with the adjusted model parameters as the initial deep learning detection model when the second error does not meet a third preset condition or the third error does not meet a fourth preset condition; and

a second training completing module, configured to confirm the training operation of the deep learning detection model being completed when the second error meets the third preset condition and the third error meets the fourth preset condition.

12. The target cell labeling apparatus of claim 11, wherein the target cell display module comprises:

a cell type acquiring unit, configured to acquire cell type of each target cell in the third image;

an icon color confirming unit, configured to confirm a display icon and/or a display color corresponding to each type of the target cell based on a preset relation; and

a target cell display unit, configured to display the target cells with the display icon and/or the display color in the third image based on the cell type.

13. A computer readable medium with computer readable instructions stored thereon, wherein, when the computer readable instructions are executed by a processor, following steps are implemented:

acquiring an original scanned image, confirming an original image format of the original scanned image, and converting the original scanned image into a first image with a preset image format;

segmenting the first image into image titles based on a preset segment manner, and recording arrangement position of each image title in the first image;

inputting each image title into a preset deep learning detection model respectively, and acquiring first position information of target cells in each image title outputted by the deep learning detection model;

confirming second position information of each target cell in the first image based on the first position information and the corresponding arrangement position;

integrating the image titles based on the arrangement position, and labeling the target cells in an integrated second image based on the arrangement position; and

converting the second image with the labeled target cells into a third image with the original image format, and displaying the third image.

14. The computer readable medium of claim 13, wherein the step of inputting the image titles corresponding to the classified group into the preset deep learning detection model, and acquiring the first position information of each target cell in the image titles outputted by the deep learning detection model comprises:

inputting each image title into a preset classified model, and acquiring a classified result outputted by the preset classified model;

confirming a classified group satisfied with a first preset condition in the classified result; and

inputting the image titles corresponding to the classified group into the preset deep learning detection model, and acquiring the first position information of each target cell in the image titles outputted by the deep learning detection model.

15. A device comprising a storage medium, a processor, and computer readable instructions stored in the storage medium; wherein, when the processor executes the computer readable instructions, the processor implements the following steps:

acquiring an original scanned image, confirming an original image format of the original scanned image, and converting the original scanned image into a first image with a preset image format;

segmenting the first image into image titles based on a preset segment manner, and recording arrangement position of each image title in the first image;

inputting each image title into a preset deep learning detection model respectively, and acquiring first position information of target cells in each image title outputted by the deep learning detection model;

confirming second position information of each target cell in the first image based on the first position information and the corresponding arrangement position;

integrating the image titles based on the arrangement position, and labeling the target cells in an integrated second image based on the arrangement position; and

converting the second image with the labeled target cells into a third image with the original image format, and displaying the third image.

16. The device of claim 15, wherein the step of acquiring an original scanned image, confirming an original image format of the original scanned image, and converting the original scanned image into a first image with a preset image format further comprises:

inputting each image title into a preset classified model, and acquiring a classified result outputted by the preset classified model;

confirming a classified group satisfied with a first preset condition in the classified result; and

inputting the image titles corresponding to the classified group into the preset deep learning detection model, and acquiring the first position information of each target cell in the image titles outputted by the deep learning detection model.

17. The device of claim 15, wherein the step of segmenting the first image into image titles based on a preset segment manner, and recording arrangement position of each image title in the first image comprises:

acquiring a distribution of the target cells and a size of the first image; and

segmenting the first image into the image titles with the preset size based on the distribution of the target cells and the size of the first image.

18. The device of any one of claims 15-17, wherein the deep learning detection model is trained by the following steps:

selecting a preset number of sample image titles;

labeling standard position information of each target cell in each sample image title based on the distribution of the target cells in each sample image title;

inputting each sample image title into an initial preset deep learning detection model, and acquiring trained position information of the target cells in each sample image title outputted by the initial deep learning detection model;

calculating a first error between the trained position information and the corresponding standard position information;

adjusting model parameters of the deep learning model and using the deep learning detection model with the adjusted model parameters as the initial deep learning detection model when the first error does not meet a second preset condition; and

confirming the training operation of the deep learning detection model to be completed when the first error meets the second preset condition.

19. The device of any one of claims 15-17, wherein the deep learning detection model is trained by the following steps:

selecting a preset number of sample image titles;

labeling standard position information and standard cell type of each target cell in each sample image title based on the distribution of the target cells in each sample image title;

inputting each sample image title into an initial preset deep learning detection model, and acquiring trained position information and trained cell type of the target cells in each sample image title outputted by the initial deep learning detection model;

calculating a second error between the trained position information and the corresponding standard position information and a third error between the trained cell type and the corresponding standard cell type;

adjusting model parameters of the deep learning model and using the deep learning detection model with the adjusted model parameters as the initial deep learning detection model when the second error does not meet a third preset condition or the third error does not meet a fourth preset condition; and

confirming the training operation of the deep learning detection model to be completed when the second error meets the third preset condition and the third error meets the fourth preset condition.

20. The device of claim 19, wherein the step of display the third image comprises the following steps:

acquiring cell type of each target cell in the third image;

confirming a display icon and/or a display color corresponding to each type of the target cell based on a preset relation; and

displaying the target cells with the display icon and/or the display color in the third image based on the cell type.