[EN]

Cell segmentation method, apparatus and readable storage medium storing program for executing

[0001] Technical field

[0002] This application involves cell segmentation fields, in particular to a kind of cell segmentation method, apparatus and readable storage medium Matter.

[0003] Background technique

[0004] Currently, general use deep learning algorithm, such as fully connected network when carrying out cell segmentation to pathological staining image Network algorithm, U-shaped neural network algorithm, region-convolutional neural networks algorithm, the region Faster-convolutional neural networks algorithm, Mask Region-convolutional neural networks algorithm etc. is completed. But no matter which kind of deep learning algorithm is used, it requires using largely marking Training sample, which is trained, can be only achieved preferable cell segmentation effect. However, current pathological staining image data has criterion Note acquisition is extremely difficult, so as to cause training dataset quantity shortage. In addition, if using the cell segmentation side of non-deep learning Method cannot then be split the individual cells in many cells region, cause segmentation effect poor.

[0005] Summary of the invention

[0006]In view of this, the embodiment of the present application is designed to provide a kind of cell segmentation method, apparatus, electronic equipment and can Storage medium is read, cell segmentation can be carried out for the pathological staining image without mark, avoid artificially collecting training dataset Workload solves the problems, such as that the individual cells in many cells region cannot be split, and then improves cell segmentation Effect.

[0007] According to the one aspect of the embodiment of the present application, a kind of electronic equipment is provided, may include that one or more storages are situated between Matter and one or more processors communicated with storage medium. One or more storage mediums are stored with the executable machine of processor Device executable instruction. When electronic equipment operation, processor executes the machine-executable instruction, to execute cell segmentation side Method.

[0008] According to another aspect of the embodiment of the present application, a kind of cell segmentation method is provided, is applied to electronic equipment, the side Method includes:

[0009] Diaminobenzidine DAB channel gray level image and hematoxylin channel gray scale are isolated from initial pathologic dye image；

[0010] Image processing is carried out to hematoxylin channel gray level image according to the channel DAB gray level image, is handled Hematoxylin channel gray level image afterwards；

[0011] Cell segmentation is carried out to treated the hematoxylin channel gray level image, obtains corresponding cell segmentation image.

[0012] It is described that diaminobenzidine DAB is isolated from initial pathologic dye image in a kind of possible embodiment the step of channel gray level image and hematoxylin channel gray level image, comprising:

[0013] The channel DAB gray level image and institute are obtained from initial pathologic dye image using cluster or matrix decomposition algorithm State typical color value of the hematoxylin channel gray level image respectively in the distribution of the initial pathologic dye image；

[0014]It is dyed respectively in the initial pathologic according to the channel DAB gray level image and hematoxylin channel gray level image Typical color value in the distribution of image carries out dyeing channel point to the initial pathologic dye image using Deconvolution Algorithm Based on Frequency From obtaining the corresponding channel DAB gray level image and hematoxylin channel gray level image.

[0015] It is described grey to the hematoxylin channel according to the channel DAB gray level image in a kind of possible embodiment It spends image and carries out image processing, the step of the hematoxylin channel gray level image that obtains that treated, comprising:

[0016] Threshold classification is carried out to the channel DAB gray level image using maximum variance between clusters；

[0017] The region for being lower than preset threshold in the gray level image of the channel DAB is rejected according to threshold classification result；

[0018] The channel the DAB gray level image progress binary conversion treatment being lower than behind the region of preset threshold will be rejected, the DAB is obtained the binary image of channel gray level image；

[0019] Image processing is carried out to hematoxylin channel gray level image according to the binary image, the Soviet Union that obtains that treated Another name for channel gray level image.

[0020] In a kind of possible embodiment, it is described according to the binary image to hematoxylin channel gray level image processing is carried out, the step of the hematoxylin channel gray level image that obtains that treated, comprising:

[0021] For the first pixel of each of hematoxylin channel gray level image, judges in the binary image and be somebody's turn to do Whether the brightness value of corresponding second pixel of the first pixel is 1；

[0022] If the brightness value of the second pixel corresponding with first pixel is 1 in the binary image, by this One pixel is rejected from the gray level image of the hematoxylin channel as pixel to be removed；

[0023] Connected component on hematoxylin channel gray level image after all pixels to be removed of rejecting is differentiated, and root the impurity in the hematoxylin channel gray level image after rejecting all pixels to be removed is rejected according to differentiation result, is obtained everywhere Hematoxylin channel gray level image after reason.

[0024] It is described according to differentiating result by the bush after rejecting all pixels to be removed in a kind of possible embodiment the step of impurity being proficient in gray level image is rejected, comprising:

[0025] It is according to differentiation as a result, area in the hematoxylin channel gray level image after all pixels to be removed of rejecting is small It is rejected in the connected component of the first setting number of pixels point, obtains the first rejecting image；

[0026] Brightness value in the first rejecting image is rejected lower than the pixel of setting brightness value, obtains the second rejecting Image；

[0027] Area in the second rejecting image is rejected less than the connected component of the second setting number of pixels point, is obtained Treated hematoxylin channel gray level image.

[0028] It is described that cell point is carried out to treated the hematoxylin channel gray level image in a kind of possible embodiment the step of cutting, obtaining corresponding cell segmentation image, comprising:

[0029] Edge detection is carried out to treated the hematoxylin channel gray level image using Laplace-Gauss operator, is obtained to treated the corresponding nucleus edge-detected image of hematoxylin channel gray level image；

[0030] Maximum value expansive working is carried out to the nucleus edge-detected image；

[0031] Obtain the Local modulus maxima that maximum value expansive working front and back brightness is constant in the nucleus edge-detected image；

[0032] Using the Local modulus maxima as seed point, using watershed algorithm in the nucleus edge-detected image Nucleus be split, obtain the corresponding cell segmentation image of the nucleus edge-detected image.

[0033] It is described that cell point is carried out to treated the hematoxylin channel gray level image in a kind of possible embodiment the step of cutting, obtaining corresponding cell segmentation image, further includes:

[0034] Reject the region that connected component area in the cell segmentation image is less than third setting number of pixels point.

[0035] It is described that cell point is carried out to treated the hematoxylin channel gray level image in a kind of possible embodiment the step of cutting, obtaining corresponding cell segmentation image, further includes:

[0036] For each cell in the cell segmentation image, for the first cut zone using expansion algorithm to the cell Pixel amplification is carried out, and the second cut zone after pixel is expanded subtracts the first cut zone of corresponding cell, obtains to the segmentation contour of the cell；

[0037] Each segmentation contour is added to respectively in the first cut zone of corresponding cell.

[0038] According to another aspect of the embodiment of the present application, a kind of cell segmentation device is provided, is applied to electronic equipment, the dress It sets and includes:

[0039] Image separation module, for isolating the channel diaminobenzidine DAB grayscale image from initial pathologic dye image Picture and hematoxylin channel gray level image；

[0040] Image processing module, for being carried out according to the channel DAB gray level image to hematoxylin channel gray level image processing, the hematoxylin channel gray level image that obtains that treated；

[0041] Cell segmentation module obtains pair for carrying out cell segmentation to treated the hematoxylin channel gray level image the cell segmentation image answered.

[0042]According to the another aspect of the embodiment of the present application, a kind of readable storage medium storing program for executing is provided, is stored on the readable storage medium storing program for executing The step of having machine-executable instruction, above-mentioned cell segmentation method can be executed when which is run by processor.

[0043]Based on any of the above-described aspect, the embodiment of the present application from initial pathologic dye image by isolating the channel DAB ash Image and hematoxylin channel gray level image are spent, and image is carried out to hematoxylin channel gray level image according to the channel DAB gray level image Processing, the hematoxylin channel gray level image that obtains that treated, finally to treated, hematoxylin channel gray level image carries out cell Segmentation, obtains corresponding cell segmentation image. It so, it is possible to carry out cell segmentation for the pathological staining image without mark, keep away Manpower-free collects the workload of training dataset, and efficiently solving cannot ask what the individual cells in many cells' region were split Topic, and then improve cell segmentation effect.

[0044] Detailed description of the invention

[0045]Technical solution in order to more clearly illustrate embodiments of the present application, below will be to needed in the embodiment attached Figure is briefly described, it should be understood that the following drawings illustrates only some embodiments of the application, therefore is not construed as pair The restriction of range for those of ordinary skill in the art without creative efforts, can also be according to this A little attached drawings obtain other relevant attached drawings.

[0046] Fig. 1 shows the flow diagram of cell segmentation method provided by the embodiment of the present application；

[0047] Fig. 2 shows the schematic diagrams of initial pathologic dye image provided by the embodiment of the present application；

[0048] Fig. 3 shows the DAB isolated provided by the embodiment of the present application from initial pathologic dye image shown in Fig. 2 The schematic diagram of channel gray level image and hematoxylin channel gray level image；

[0049] Fig. 4 shows the binary image of the channel DAB gray level image shown in Fig. 3 provided by the embodiment of the present application Schematic diagram；

[0050] Fig. 5, which shows to reject in hematoxylin channel gray level image shown in Fig. 3 provided by the embodiment of the present application, to be owned the schematic diagram of hematoxylin channel gray level image after pixel to be removed；

[0051] Fig. 6 shows the impurity that hematoxylin channel gray level image shown in Fig. 5 is rejected provided by the embodiment of the present application Schematic diagram afterwards；

[0052] Fig. 7 is shown provided by the embodiment of the present application using Log operator to hematoxylin channel shown in fig. 6 gray level image Carry out the schematic diagram for the nucleus edge-detected image that edge detection obtains；

[0053] Fig. 8 shows and carries out maximum to nucleus edge-detected image shown in fig. 7 provided by the embodiment of the present application Schematic diagram after being worth expansive working；

[0054] Fig. 9 is shown and is examined using watershed algorithm to cell nuclear periphery shown in fig. 7 provided by the embodiment of the present application the schematic diagram for the cell segmentation image that nucleus in altimetric image is split；

[0055] Figure 10 shows pair of final cell segmented image and control cell segmented image provided by the embodiment of the present application Than one of schematic diagram；

[0056] Figure 11 a and Figure 11 b respectively illustrate final cell segmented image and control cell provided by the embodiment of the present application the two of the contrast schematics diagrams of segmented image；

[0057] Figure 12 a and Figure 12 b respectively illustrate final cell segmented image and control cell provided by the embodiment of the present application the three of the contrast schematics diagrams of segmented image；

[0058] Figure 13 a and Figure 13 b respectively illustrate final cell segmented image and control cell provided by the embodiment of the present application the three of the contrast schematics diagrams of segmented image；

[0059] Figure 14 shows the functional module signal for the cell segmentation device that the provided electronic equipment of the embodiment of the present application includes Figure.

[0060] Specific embodiment

[0061]To keep the purposes, technical schemes and advantages of the embodiment of the present application clearer, below in conjunction with the embodiment of the present application In attached drawing, the technical scheme in the embodiment of the application is clearly and completely described, it should be understood that attached drawing in the application The purpose of illustration and description is only played, is not used to limit the protection scope of the application. In addition, it will be appreciated that schematically attached Figure does not press scale. Process used herein shows real according to some embodiments of the embodiment of the present application Existing operation. It should be understood that the operation of flow chart can be realized out of order, the step of context relation of logic can be with Reversal order is implemented simultaneously. In addition, those skilled in the art under the guide of teachings herein, can add to flow chart Other one or more operations, can also remove one or more operations from flow chart.

[0062] In addition, described embodiments are only a part of embodiments of the present application, instead of all the embodiments. Usually exist the component of the embodiment of the present application described and illustrated in attached drawing can be arranged and be designed with a variety of different configurations herein. Cause This, is not intended to limit claimed the applications to the detailed description of the embodiments herein provided in the accompanying drawings below Range, but it is merely representative of the selected embodiment of the application. Based on embodiments herein, those skilled in the art are not being done Every other embodiment obtained under the premise of creative work out, shall fall in the protection scope of this application.

[0063] Fig. 1 shows the flow diagram of cell segmentation method provided by the embodiments of the present application. It should be appreciated that in other realities It applies in example, the sequence of the cell segmentation method part step of the present embodiment cannot be with Fig. 1 and following specific embodiments Sequence is limitation, such as can be exchanged with each other according to actual needs or part steps therein also can be omitted or delete. It should the detailed step of cell segmentation method is described below.

[0064] Step S110 isolates diaminobenzidine DAB (Diaminobenzidine) from initial pathologic dye image Channel gray level image and hematoxylin channel gray scale (Hematoxylin) image.

[0065] In a kind of possible embodiment, can using cluster or matrix decomposition algorithm (such as gauss hybrid models calculate Method) channel DAB gray level image is obtained from initial pathologic dye image and hematoxylin channel gray level image exists respectively Typical color value in the distribution of the initial pathologic dye image. It on this basis, can be according to the channel DAB grayscale image Picture and the hematoxylin channel gray level image typical color value in the distribution of the initial pathologic dye image respectively, use Deconvolution Algorithm Based on Frequency to the initial pathologic dye image carry out dyeing channel separation, obtain the corresponding channel DAB gray level image and Hematoxylin channel gray level image.

[0066]It wherein, can be initial from this using the above scheme for using example shown in Fig. 2 as initial pathologic dye image It is (right that the channel DAB gray level image (left figure) and hematoxylin channel gray level image shown in Fig. 3 are isolated in pathological staining image Figure).It can be seen that Fig. 3 is the channel the DAB gray level image (left figure) and hematoxylin channel gray level image (right figure) after separation Intensity is clearly present complementation, it was demonstrated that channel separation significant effect.

[0067] Step S120 carries out image processing to hematoxylin channel gray level image according to the channel DAB gray level image, the hematoxylin channel gray level image that obtains that treated.

[0068] Step S130 carries out cell segmentation to treated the hematoxylin channel gray level image, obtains corresponding cell Segmented image.

[0069]The present embodiment from initial pathologic dye image by isolating the channel DAB gray level image and hematoxylin channel gray scale Image, and image processing is carried out to hematoxylin channel gray level image according to the channel DAB gray level image, the hematoxylin that obtains that treated Channel gray level image, finally to treated, hematoxylin channel gray level image carries out cell segmentation, obtains corresponding cell segmentation Image. It so, it is possible to carry out cell segmentation for the pathological staining image without mark, avoid the work for artificially collecting training dataset It measures, solves the problems, such as that the individual cells in many cells' region cannot be split, and then improve cell segmentation effect Fruit.

[0070] In a kind of possible embodiment, for step S120, it is possible, firstly, to using maximum variance between clusters to described the channel DAB gray level image carries out threshold classification. The channel DAB gray level image is divided into foreground picture for example, can use threshold value Picture and background image. Wherein, n1 can be used in foreground image, scum, m1 are illustrated respectively in the point of the prospect under present threshold value Number, moment of mass, average gray； N2 can be used in background image, sum-scum, m2 indicate the background under present threshold value Points, moment of mass, average gray. Assuming that t is the segmentation threshold of foreground image and background image, prospect points account for image scaled and are W0, average gray u0； It is w1, average gray u1 that background points, which account for image scaled,

[0071] The then overall average gray scale of the channel DAB gray level image are as follows: u=w0*u0+w1*u1, then foreground image and background the variance of image is then are as follows:

[0072] G=w0* (u0-u) * (u0-u) +w1* (u1-u) * (u1-u) =w0*w1* (u0-u1) * (u0-u1)

[0073]On this basis, it can assert that foreground image at this time and background image difference are maximum, at this time in variance g maximum Gray scale to be optimal threshold sb=w0*w1* (u1-u0) * (u0-u1), the channel DAB ash is then obtained according to optimal threshold Spend image threshold classification results.

[0074]Thus, it is possible to the region for being lower than preset threshold in the gray level image of the channel DAB is rejected according to threshold classification result, And the channel the DAB gray level image progress binary conversion treatment being lower than behind the region of preset threshold will be rejected, obtain the channel the DAB ash Spend the binary image of image. For the channel the DAB gray level image shown in Fig. 3, which is referred to Fig. 4 institute Show, as can be seen from Figure 4 the channel DAB is distributed in around each nucleus.

[0075] Then, image processing is carried out to hematoxylin channel gray level image according to the binary image, is handled Hematoxylin channel gray level image afterwards.

[0076] For example, can judge the binarization for the first pixel of each of hematoxylin channel gray level image Whether the brightness value of the second pixel corresponding with first pixel is 1 in image. If in the binary image with this the brightness value of corresponding second pixel of one pixel is 1, then using first pixel as pixel to be removed from the Soviet Union It is rejected in the gray level image of another name for channel. In this way, by using the binary image of the channel DAB gray level image to hematoxylin channel ash Degree image carries out removal of impurities optimization, can effectively improve subsequent cell segmentation effect.

[0077]For binary image shown in hematoxylin channel gray level image and Fig. 4 shown in Fig. 3, the rejecting is all Hematoxylin channel gray level image after pixel to be removed is referred to shown in Fig. 5, it can be seen that hematoxylin channel image uses The filtered cell outline of DAB channel image is more obvious.

[0078]Then, the connected component on the hematoxylin channel gray level image after all pixels to be removed of rejecting is sentenced Not, and according to differentiation result by the impurity in the hematoxylin channel gray level image after rejecting all pixels to be removed it picks It removes, the hematoxylin channel gray level image that obtains that treated.

[0079] For example, can be according to differentiation as a result, by the hematoxylin channel grayscale image after all pixels to be removed of rejecting Area is rejected less than the connected component of the first setting number of pixels point as in, obtains the first rejecting image. It then, will be described Brightness value is rejected lower than the pixel of setting brightness value in first rejecting image, obtains the second rejecting image. Finally, by institute the connected component that area in the second rejecting image is stated less than the second

setting number of pixels point is rejected, the bush that obtains that treated It is proficient in gray level image.

[0080]Wherein, for each connected component, area can be indicated with the pixel quantity that it includes, in this way, By setting the first setting quantity, the hematoxylin channel gray level image after all pixels to be removed of rejecting can be carried out preliminary Removal of impurities processing, image then rejected to first by setting brightness value carry out the removal of impurities of pixel and handle, when eliminating After partial pixel point, connected component may change a lot, therefore also need to set the second setting quantity to second The further removal of impurities processing of image progress is rejected to avoid omitting extrinsic region in deducing step to improve impurity-eliminating effect.

[0081] Optionally, the first setting quantity above-mentioned, setting brightness value and the second setting quantity can be according to actual designs Demand is configured. For example, the first setting quantity can be 32, setting brightness value can be 23, and the second setting quantity can be 16。

[0082]For rejecting the hematoxylin channel gray level image after all pixels to be removed shown in Fig. 5, after the processing Hematoxylin channel gray level image be referred to shown in Fig. 6, it can be seen that should treated that hematoxylin channel gray level image is only protected Nuclear fractions have been stayed, the residual fraction of acellular is eliminated.

[0083] In a kind of possible embodiment, for step S130, Log (Gauss-Laplace) operator pair is used first Treated the hematoxylin channel gray level image carries out edge detection, obtains treated the hematoxylin channel gray level image Corresponding nucleus edge-detected image. By taking treated shown in Fig. 6 hematoxylin channel gray level image as an example, the nucleus Edge-detected image is referred to shown in Fig. 7, it can be seen that the edge pixel intensity of the nucleus edge-detected image gets higher (face Color cast is white).

[0084]Wherein, to treated, hematoxylin channel gray level image carries out post fitted orbit processing to Log operator first, mostly Ground inhibits noise, then seeks edge to smoothed out image. Since (gray scale and surrounding point differ by more than given threshold to noise spot Pixel) it has a certain impact to edge detection, so Log operator is Gauss smoothing filter and Laplacian sharp filtering Device combines rear smooth out noise, then carries out edge detection, to improve edge detection effect.

[0085] Then, maximum value expansive working is carried out to the nucleus edge-detected image.With nucleus side shown in fig. 7 For edge detection image, the nucleus edge-detected image after the maximum value expansive working is referred to shown in Fig. 8, it can be seen that Nucleus edge-detected image after locating the maximum value expansive working remains endonuclear Local Extremum, and convenient is laggard The processing of row watershed algorithm.

[0086] Optionally, the expansion radius during above-mentioned expansive working can be configured according to the actual situation, as an example, the expansion radius can be 5 pixels.

[0087]Then, brightness is obtained in nucleus edge-detected image for example shown in fig. 8 before and after maximum value expansive working not The Local modulus maxima of change, and using the Local modulus maxima as seed point (seed), it is calculated using watershed (watershed) Method is split the nucleus in nucleus edge-detected image for example shown in fig. 7, obtains the cell nuclear periphery inspection The corresponding cell segmentation image of altimetric image, the cell segmentation image may include the first cut zone of each cell. The cell point It cuts image to be referred to shown in Fig. 9, it can be seen that carried out significant segmentation for the shape of cell.

[0088] Optionally, it is small can also to reject connected component area in the cell segmentation image on the basis of the above for the present embodiment Cell segmentation effect is improved in the region of third setting number of pixels point further to reject impurity. Illustratively, third Setting quantity can be 12.

[0089] Optionally, the present embodiment for each cell in the cell segmentation image, can also use on the basis of the above Expansion algorithm carries out pixel amplification (such as one pixel of amplification) to the first cut zone of the cell, and pixel is expanded The second cut zone afterwards subtracts the first cut zone of the cell, obtains the segmentation contour of the cell, then respectively will be each Segmentation contour is added in the first cut zone of corresponding cell. For example, it is assumed that including cell in the cell segmentation image A, cell b and cell c is obtained then can be carried out the amplification of a pixel to the first cut zone of cell a using expansion algorithm To the second cut zone of cell a, then the second cut zone is subtracted to the dividing wheel of the first cut zone then available cell a It is wide. And so on, the segmentation contour of cell b and cell c can be respectively obtained. On this basis, by corresponding second point Region is cut to be added to respectively on cell a, cell b and cell c.

[0090] As an example, the cell segmentation image after superposition segmentation contour please refers to shown in Figure 10, left figure is according to the channel DAB Gray level image hematoxylin channel gray level image is optimized after image, right figure be not according to the channel DAB gray level image after optimizing to hematoxylin channel gray level image, the black border in left figure and right figure is then above-mentioned segmentation Profile. So as can be seen that the cell segmentation image after superposition segmentation contour can be improved in the cell segmentation image each The explanation conspicuousness of cell, and according to the channel DAB gray level image can effectively to hematoxylin channel gray level image into Row optimization, to solve the problems, such as in the prior art not being split the individual cells in many cells region, and for the right side The part of more erroneous segmentation and omission segmentation is improved in figure, and then improves cell segmentation effect.

[0091] It cannot be asked what the individual cells in many cells region were split to further prove that the present embodiment can solve Topic, improves the accuracy of cell segmentation, i.e., can be effectively to hematoxylin channel grayscale image according to the channel DAB gray level image As optimizing, below with reference to Figure 11 a, 11b- Figure 13 a, 13b to save an initial pathologic dye image with above-described embodiment The different process of phase She carries out cell segmentation.

[0092] It is worth noting that for using the process of above-described embodiment progress cell segmentation in Figure 11 a, Figure 12 a, Figure 13 a； In Figure 11 b, Figure 12 b, Figure 13 b, hematoxylin channel gray level image is optimized herein according to the channel DAB gray level image It is skipped in experiment； Meanwhile it being superimposed the expansion radius reduction during segmentation contour, dividing wheel profile attenuates, it is easier to differentiate Different from the cut zone of previous embodiment, (due to using, there are impurity to reject step, cut zone before expansion algorithm out Form have influenced invariably by dividing wheel profile thickness).

[0093] By Figure 11 a, Figure 11 b, Figure 12 a, Figure 12 b cell whether there is or not comparison and Figure 13 a, Figure 13 b subregion whether there is or not Impurity interference comparison, it is not difficult to find out that, the cell segmentation accuracy of Figure 11 a, Figure 12 a, Figure 13 a be apparently higher than Figure 11 b, Figure 12 b, Figure 13 therefore, during cell segmentation, hematoxylin channel gray level image is carried out using the channel DAB gray level image excellent Change, cell segmentation effect can be improved.

[0094] Figure 14 shows the schematic diagram of electronic equipment 100 provided by the embodiments of the present application, in the present embodiment, the electronic equipment 100 may include storage medium 110, processor 120 and cell segmentation device 130.

[0095] Wherein, processor 120 can be a general central processing unit (Central Processing Unit, CPU), microprocessor, application-specific integrated circuit (Application-Specific Integrated Circuit, ASIC), Or the integrated circuit that one or more programs for controlling the cell segmentation method of above method embodiment offer execute.

[0096]Storage medium 110 can be ROM or can store the other kinds of static storage device of static information and instruction, RAM or the other kinds of dynamic memory that can store information and instruction, are also possible to the read-only storage of electric erasable programmable Device (Electrically Erasable Programmable-Only Memory, EEPROM), CD-ROM (Compact disc Read-Only Memory, CD-ROM) or other optical disc storages, optical disc storage (including compression optical disc, swash Optical disc, optical disc, Digital Versatile Disc, Blu-ray Disc etc.), magnetic disk storage medium or other magnetic storage apparatus or can use In carry or storage have instruction or data structure form desired program code and can by computer access it is any it's His medium, but not limited to this. Storage medium 110, which can be, to be individually present, and is connected by communication bus with processor 120.It deposits Storage media 110 can also be integrated with processor. Wherein, storage medium 110, which is used to store, executes answering for application scheme With program code, such as cell segmentation device 130 shown in Figure 14, and execution is controlled by processor 120.Processor 120 For executing the application code stored in storage medium 110, such as cell segmentation device 130, to execute above method reality Apply the cell segmentation method of example.

[0097] The application can carry out the division of functional module according to above method embodiment to cell segmentation device 130, for example, each functional module of each function division can be corresponded to, two or more functions can also be integrated in a

processing mound in block. Above-mentioned integrated module both can take the form of hardware realization, can also be realized in the form of software function module. It should be noted that being schematically, only a kind of logical function partition to the division of module in the application, in actual implementation There may be another division manner. For example, Figure 14 is shown in the case where each function division of use correspondence each functional module Cell segmentation device 130 be a kind of schematic device, separately below to each functional module of the cell segmentation device 130 Function be described in detail.

[0098] Image separation module 131, for isolating the channel diaminobenzidine DAB gray scale from initial pathologic dye image and hematoxylin channel gray level image. It is appreciated that the image separation module 131 can be used for executing above-mentioned steps S110, Detailed implementation about the image separation module 131 is referred to above-mentioned to the related content of step S110.

[0099] Image processing module 132, for according to the channel DAB gray level image to hematoxylin channel gray level image into Row image processing, the hematoxylin channel gray level image that obtains that treated. It is appreciated that the image processing module 132 can be used for Above-mentioned steps S120 is executed, the detailed implementation about the image processing module 132 is referred to above-mentioned have step S120 the content of pass.

[0100] Cell segmentation module 133 is obtained for carrying out cell segmentation to treated the hematoxylin channel gray level image Corresponding cell segmentation image. It is appreciated that the cell segmentation module 133 can be used for executing above-mentioned steps S130, about this the detailed implementation of cell segmentation module 133 is referred to above-mentioned to the related content of step S130.

[0101]Since cell segmentation device 130 provided by the embodiments of the present application is the another kind of cell segmentation method shown in FIG. 1 Way of realization, and cell segmentation device 130 can be used for executing method provided by embodiment shown in FIG. 1, therefore it can be obtained The technical effect obtained can refer to above method embodiment, and details are not described herein.

[0102] Further, based on the same inventive concept, the embodiment of the present application also provides a kind of computer readable storage medium, it is stored with computer program on the computer readable storage medium, which executes above-mentioned cell when being run by processor the step of dividing method.

[0103] Specifically, which can be general storage medium, such as mobile disk, hard disk, on the storage medium Computer program when being run, be able to carry out above-mentioned cell segmentation method.

[0104] The embodiment of the present application be referring to according to the method for the embodiment of the present application, equipment (electronic equipment 100 of such as Figure 14) and the flowchart and/or the block diagram of computer program product describes. It should be understood that flow chart can be realized by computer program instructions and/or the knot of the process and/or box in each flow and/or block and flowchart and/or the block diagram in

block diagram It closes. These computer program instructions be can provide to general purpose computer, special purpose computer, Embedded Processor or other programmable numbers According to the processor of processing equipment to generate a machine, so that passing through the processing of computer or other programmable data processing devices The instruction that device executes generates for realizing in one box of one or more flows of the flowchart and/or block diagram or multiple sides The device for the function of being specified in frame.

[0105]Although the application is described in conjunction with each embodiment herein, however, implementing the application claimed In the process, those skilled in the art are by checking the attached drawing, disclosure and the appended claims, it will be appreciated that and it is real Other variations of the existing open embodiment. In the claims, one word of " comprising " is not excluded for other components or step, "a" or "an" is not excluded for multiple situations. Single processor or other units may be implemented to enumerate in claim several Item function. Mutually different has been recited in mutually different dependent certain measures, it is not intended that these measures cannot group close to generate good effect.

[0106]The above, the only various embodiments of the application, but the protection scope of the application is not limited thereto, it is any Those familiar with the art within the technical scope of the present application, can easily think of the change or the replacement, and should all contain Lid is within the scope of protection of this application. Therefore, the protection scope of the application shall be subject to the protection scope of the claim.