METHOD AND APPARATUS FOR DETECTING DEALING SEQUENCE, STORAGE MEDIUM AND ELECTRONIC DEVICE

Technical Field

The present disclosure relates to the field of computer vision, and in particular, to a method and apparatus for detecting dealing sequence, a storage medium and electronic device.

Background

Currently, in a dealing process of a game, game cards are manually allocated, and a person who allocates the game cards continuously performs mechanical dealing, which may cause an error.

Summary

The present disclosure provides a method and apparatus for detecting dealing sequence, a storage medium, and an electronic device.

A method for detecting dealing sequence provided according to a first aspect of the embodiments of the present disclosure includes: obtaining a video stream of a game desktop, and performing game card detection on multiple image frames included in the video stream; in response to detecting a newly added game card in at least one image frame in the video stream, determining whether the newly added game card is in a target state in which allocation ends; after the newly added game card is in the target state in which allocation ends, determining game information corresponding to the newly added game card; and determining, based on the game information, whether a sequence of allocating the newly added game card conforms to a predetermined dealing sequence.

In some optional embodiments, the performing game card detection on multiple image frames included in the video stream includes: inputting each image frame in the video stream into an object detection neural network to obtain an object detection result output by the object detection neural network, where the object detection result at least includes whether each image frame in the video stream includes a game card and a location of a game card in an image that includes the game card.

In some optional embodiments, the determining whether the newly added game card is in a target state in which allocation ends includes: determining, in a predetermined number of image frames that include the newly added game card, a distance between locations of the newly added

game card in any two image frames among the predetermined number of image frames; determining whether the distance between the locations satisfies a predetermined distance condition; and under the condition that the distance satisfies the predetermined distance condition, determining that the newly added game card is in the target state in which allocation ends.

In some optional embodiments, the determining, in a predetermined number of image frames that include the newly added game card, a distance between locations of the newly added game card in any two image frames among the predetermined number of image frames includes: determining respectively, in at least two adjacent image frames among the predetermined number of image frames, a motion trajectory of each game card included in the at least two adjacent image frames, where the at least two adjacent image frames include a current image frame and a previous image frame that is adjacent to the current image frame; predicting, based on the motion trajectory of each game card in the at least two adjacent image frames, a predicted location of each game card in a next image frame that is adjacent to the current image frame; obtaining a detected location of each game card included in the next image frame; matching the predicted location with the detected location to determine a location of the newly added game card in the next image frame; and determining the distance between the locations of the newly added game card in any two image frames among the predetermined number of image frames based on the locations of the newly added game card in any two image frames among the predetermined number of image frames.

In some optional embodiments, the determining whether the distance between the locations satisfies a predetermined distance condition includes: determining a first area of an overlapping part of target bounding boxes of the newly added game card in any two image frames among the predetermined number of image frames, and a second area occupied by the target bounding boxes of the newly added game card in any two image frames among the predetermined number of image frames other than the first area; taking a sum of the first area and the second area as a third area; and if a quotient of the first area and the third area is greater than a predetermined value, determining that the distance between the locations of the newly added game card in any two image frames among the predetermined number of image frames satisfies the predetermined distance condition.

In some optional embodiments, the game information corresponding to the newly added game card includes at least one of the following: game location information of the newly added game card on the game desktop, allocation sequence information of the newly added game card in a game, or game identifier information of the newly added game card, where the game identifier information includes at least one of a pattern or a figure.

In some optional embodiments, the game information includes the game location information of the newly added game card on the game desktop, and the determining game information corresponding to the newly added game card includes: taking, based on a location of the newly added game card in at least one image frame when the newly added game card is in the target state in which allocation ends, and on regions that are divided on the game desktop in advance and correspond to different game players, a region of a game player to which the location of the newly added game card belongs as the game location information of the newly added game card on the game desktop; and the determining, based on the game information, whether a sequence of allocating the newly added game card conforms to a predetermined dealing sequence includes: determining, based on a specified allocation sequence of regions corresponding to different game players, a specified region where the newly added game card should be located; and under the condition that the region of the game player to which the location of the newly added game card belongs is consistent with the specified region, and a total number of game cards currently included in the region of the game player to which the location of the newly added game card belongs is less than or equal to a first predetermined value, determining that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

In some optional embodiments, the game information includes the allocation sequence information of the newly added game card in the game, and the determining game information corresponding to the newly added game card includes: determining the number of game cards in a target region when the newly added game card is in the target state in which allocation ends, where the target region is a region where game cards in the target state in which allocation ends on the game desktop are located; and taking the number of game cards in the target region as the allocation sequence information of the newly added game card in the game; and the determining, based on the game information, whether a sequence of allocating the newly added game card conforms to a predetermined dealing sequence includes: determining whether the number of the game cards in the target region is less than or equal to a second predetermined value; and under the condition that the number of the game cards in the target region is less than or equal to the second predetermined value, determining that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

In some optional embodiments, the game information includes the game identifier information of the newly added game card and the allocation sequence information of the newly added game card in the game, and the determining game information corresponding to the newly added game card includes: determining a figure of the newly added game card based on at least one image

frame that includes the newly added game card; determining the number of game cards in a target region when the newly added game card is in the target state in which allocation ends, where the target region is a region where game cards in the target state in which allocation ends on the game desktop are located; and taking the number of the game cards in the target region as the allocation sequence information of the newly added game card in the game; and the determining, based on the game information, whether a sequence of allocating the newly added game card conforms to a predetermined dealing sequence includes: determining a sum of figure of all the game cards except the newly added game card in the target region; and under the condition that the number of the game cards in the target region is greater than or equal to a second predetermined value and less than a third predetermined value, and the sum of figure does not exceed a preset sum of figure, determining that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

An apparatus for detecting dealing sequence provided according to a second aspect of the embodiments of the present disclosure includes: an execution module, configured to: obtain a video stream of a game desktop, and perform game card detection on multiple image frames included in the video stream; a first determining module, configured to: in response to detecting a newly added game card in at least one image frame in the video stream, determine whether the newly added game card is in a target state in which allocation ends; a second determining module, configured to: after the newly added game card is in the target state in which allocation ends, determine game information corresponding to the newly added game card; and a third determining module, configured to determine, based on the game information, whether a sequence of allocating the newly added game card conforms to a predetermined dealing sequence.

In some optional embodiments, the execution module is configured to input each image frame in the video stream into an object detection neural network to obtain an object detection result output by the object detection neural network, where the object detection result at least includes whether each image frame in the video stream includes a game card and a location of a game card in an image that includes the game card.

In some optional embodiments, the first determining module includes: a first determining sub-module, configured to determine, in a predetermined number of image frames that include the newly added game card, a distance between locations of the newly added game card in any two image frames among the predetermined number of image frames; a second determining sub-module, configured to determine whether the distance between the locations satisfies a predetermined distance condition; and a third determining sub-module, configured to: under the

condition that the distance satisfies the predetermined distance condition, determine that the newly added game card is in the target state in which allocation ends.

In some optional embodiments, the first determining sub-module includes: a first determining unit, configured to determine respectively, in at least two adjacent image frames among the predetermined number of image frames, a motion trajectory of each game card included in the at least two adjacent image frames, where the at least two adjacent image frames include a current image frame and a previous image frame that is adjacent to the current image frame; a predicting unit, configured to predict, based on the motion trajectory of each game card in the at least two adjacent image frames, a predicted location of each game card in a next image frame that is adjacent to the current image frame; an obtaining unit, configured to obtain a detected location of each game card included in the next image frame; a second determining unit, configured to match the predicted location with the detected location to determine a location of the newly added game card in the next image frame; and a third determining unit, configured to determine the distance between the locations of the newly added game card in any two image frames among the predetermined number of image frames based on the locations of the newly added game card in any two image frames among the predetermined number of image frames.

In some optional embodiments, the second determining sub-module includes: a fourth determining unit, configured to determine a first area of an overlapping part of target bounding boxes of the newly added game card in any two image frames among the predetermined number of image frames, and a second area occupied by the target bounding boxes of the newly added game card in any two image frames among the predetermined number of image frames other than the first area; a fifth determining unit, configured to take a sum of the first area and the second area as a third area; and a sixth determining unit, configured to: if a quotient of the first area and the third area is greater than a predetermined value, determine that the distance between the locations of the newly added game card in any two image frames among the predetermined number of image frames satisfies the predetermined distance condition.

In some optional embodiments, the game information corresponding to the newly added game card includes at least one of the following: game location information of the newly added game card on the game desktop, allocation sequence information of the newly added game card in a game, or game identifier information of the newly added game card, where the game identifier information includes at least one of a pattern or a figure.

In some optional embodiments, the game information includes the game location information of the newly added game card on the game desktop, and the second determining module includes:

a fourth determining sub-module, configured to take, based on a location of the newly added game card in at least one image frame when the newly added game card is in the target state in which allocation ends, and on regions that are divided on the game desktop in advance and correspond to different game players, a region of a game player to which the location of the newly added game card belongs as the game location information of the newly added game card on the game desktop; and the third determining module includes: a fifth determining sub-module, configured to determine, based on a specified allocation sequence of regions corresponding to different game players, a specified region where the newly added game card should be located; and a sixth determining sub-module, configured to: under the condition that the region of the game player to which the location of the newly added game card belongs is consistent with the specified region, and a total number of game cards currently included in the region of the game player to which the location of the newly added game card belongs is less than or equal to a first predetermined value, determine that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

In some optional embodiments, the game information includes the allocation sequence information of the newly added game card in the game, and the second determining module includes: a seventh determining sub-module, configured to determine the number of game cards in a target region when the newly added game card is in the target state in which allocation ends, where the target region is a region where game cards in the target state in which allocation ends on the game desktop are located; and an eighth determining sub-module, configured to take the number of the game cards in the target region as the allocation sequence information of the newly added game card in the game; and the third determining module includes: a ninth determining sub-module, configured to determine whether the number of the game cards in the target region is less than or equal to a second predetermined value; and a tenth determining sub-module, configured to: under the condition that the number of the game cards in the target region is less than or equal to the second predetermined value, determine that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

In some optional embodiments, the game information includes the game identifier information of the newly added game card and the allocation sequence information of the newly added game card in the game, and the second determining module includes: an eleventh determining sub-module, configured to determine a figure of the newly added game card based on at least one image frame that includes the newly added game card; a twelfth determining sub-module, configured to determine the number of game cards in a target region when the newly added game

card is in the target state in which allocation ends, where the target region is a region where game cards in the target state in which allocation ends on the game desktop are located; and a thirteenth determining sub-module, configured to take the number of the game cards in the target region as the allocation sequence information of the newly added game card in the game; and the third determining module includes: a fourteenth determining sub-module, configured to determine a sum of figure of all the game cards except the newly added game card in the target region; and a fifteenth determining sub-module, configured to: under the condition that the number of the game cards in the target region is greater than or equal to a second predetermined value and less than a third predetermined value, and the sum of figure does not exceed a preset sum of figure, determine that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

A computer-readable storage medium provided according to a third aspect of the embodiments of the present disclosure stores a computer program, and the computer program is configured to perform the method for detecting dealing sequence according to any item of the first aspect.

An electronic device provided according to a fourth aspect of the embodiments of the present disclosure includes: a processor; and a memory configured to store instructions executable by the processor; where the processor is configured to invoke the executable instructions stored in the memory to implement the method for detecting dealing sequence according to any item of the first aspect.

The technical solutions provided in the embodiments of the present disclosure include the following beneficial effects:

In the embodiments of the present disclosure, a video stream of a game desktop is obtained, and game card detection is performed on multiple image frames included in the video stream. If a newly added game card is detected in at least one image frame in the video stream, whether the newly added game card is in a target state in which allocation ends is determined. After the newly added game card is in the target state in which allocation ends, game information corresponding to the newly added game card is determined, so as to automatically determine, based on the game information, whether a sequence of allocating the newly added game card conforms to a predetermined dealing sequence, so that when the sequence of allocating the newly added game card does not conform to the predetermined dealing sequence, warning information may be sent to a game controller, such as a dealer, to inform the game controller of a dealing error. In the embodiments of the present disclosure, whether a dealing sequence satisfies the predetermined dealing sequence may be automatically detected, so as to reduce man-made allocation errors, and

improve intelligence of a game process.

It should be understood that the above general description and the following detailed description are merely exemplary and explanatory, and are not intended to limit the present disclosure.

Brief Description of the Drawings

The accompanying drawings here, which are incorporated into the specification and constitute a part of the specification, illustrate embodiments that conform to the present disclosure and are used together with the specification to explain the principles of the present disclosure.

FIG. 1 is a flowchart of a method for detecting dealing sequence according to one exemplary embodiment of the present disclosure;

FIG. 2 is a schematic diagram of a scenario in a dealing process according to one exemplary embodiment of the present disclosure;

FIG. 3 is a schematic diagram of a scenario at multiple views according to one exemplary embodiment of the present disclosure;

FIG. 4 is a schematic diagram of a dealing sequence detection scenario according to one exemplary embodiment of the present disclosure;

FIG. 5 is a flowchart of another method for detecting dealing sequence according to one exemplary embodiment of the present disclosure;

FIG. 6 is a flowchart of another method for detecting dealing sequence according to one exemplary embodiment of the present disclosure;

FIG. 7A to FIG. 7C are schematic diagrams of a dealing sequence detection scenario according to one exemplary embodiment of the present disclosure;

FIG. 8 is a flowchart of another method for detecting dealing sequence according to one exemplary embodiment of the present disclosure;

FIG. 9 is a schematic diagram of a dealing sequence detection scenario according to one exemplary embodiment of the present disclosure;

FIG. 10 is a flowchart of another method for detecting dealing sequence according to one exemplary embodiment of the present disclosure;

FIG. 11 is a flowchart of another method for detecting dealing sequence according to one exemplary embodiment of the present disclosure;

FIG. 12 is a flowchart of another method for detecting dealing sequence according to one exemplary embodiment of the present disclosure;

FIG. 13 is a flowchart of another method for detecting dealing sequence according to one exemplary embodiment of the present disclosure;

FIG. 14 is a flowchart of another method for detecting dealing sequence according to one exemplary embodiment of the present disclosure;

FIG. 11 is a flowchart of another method for detecting dealing sequence according to one exemplary embodiment of the present disclosure;

FIG. 15 is a block diagram of an apparatus for detecting dealing sequence according to one exemplary embodiment of the present disclosure; and

FIG. 16 is a schematic structural diagram of an electronic device for detecting dealing sequence according to one exemplary embodiment of the present disclosure.

Detailed Description

Exemplary embodiments will be described here in detail, and examples thereof are represented in the accompanying drawings. When the following description relates to the accompanying drawings, unless otherwise indicated, the same numbers in different accompanying drawings represent the same or similar elements. The implementations described in the following exemplary embodiments do not represent all implementations consistent with the present disclosure. On the contrary, they are merely examples of apparatuses and methods consistent with some aspects of the present disclosure as detailed in the appended claims.

Terms in the present disclosure are merely for describing specific embodiments and are not intended to limit the present disclosure. The singular forms "one", "the", and "this" in the present disclosure and the appended claims are also intended to include most forms unless the context clearly represents other meanings. It should also be understood that the term "and/or" in the present disclosure refers to and include any or all of possible combinations of one or more associated listed items.

It should be understood that although terms "first", "second", "third", and the like are used in the embodiments of the present disclosure to describe various information, the information is not limited to the terms. These terms are only used to differentiate information of a same type. For example, without departing from the scope of the present disclosure, first information is also referred to as second information, and similarly the second information is also referred to as the

first information. Depending on the context, for example, the word "if" used here may be explained as "while" or "when" or "in response to determining".

The embodiments of the present disclosure provide a method for detecting dealing sequence, which is applied to an electronic device in each game venue. The electronic device includes a camera for collecting a video stream, and automatically detecting a dealing sequence by using the video stream collected by the electronic device.

As shown in FIG. 1, which shows a method for detecting dealing sequence according to one exemplary embodiment, the method includes the following steps.

At step 101, a video stream of a game desktop is obtained, and game card detection is performed on multiple image frames included in the video stream.

In the embodiments of the present disclosure, to automatically determine whether a dealing sequence is correct, when game card detection is performed on the multiple image frames included in the video stream, detection is mainly performed on each newly added game card.

At step 102, in response to detecting a newly added game card in at least one image frame in the video stream, it is determined whether the newly added game card is in a target state in which allocation ends.

In the embodiments of the present disclosure, if a newly added game card is detected in at least one image frame in the video stream, for example, there is no game card previously, or there are M game cards previously, if one game card is newly added, whether the newly added game card is in the target state in which allocation ends may be determined.

In the embodiments of the present disclosure, for example, as shown in FIG. 2, it is assumed that there are two players in total on a game desktop. The left half of the game desktop is a region where a game player 1 is located, and the right half is a region where a game player 2 is located. If a predetermined dealing sequence is that a current newly added game card should be dealt to the game player 2, in a dealing process, the newly added game card may pass the region where the game player 1 is located and is then placed in the region where the game player 2 is located. Misjudgment is easily caused if it is determined, in the case that the newly added game card is not in the target state in which allocation ends, whether a sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

Therefore, to improve the accuracy of the dealing sequence detection, it is necessary to determine whether the newly added game card is in the target state in which allocation ends, and

then to perform subsequent steps.

At step 103, after the newly added game card is in the target state in which allocation ends, game information corresponding to the newly added game card is determined.

The game information includes but is not limited to one or a combination of the following: game location information of the newly added game card on the game desktop, allocation sequence information of the newly added game card in a game, or game identifier information of the newly added game card. The game identifier information includes at least one of a pattern or a figure of the newly added game card.

In the embodiments of the present disclosure, the game location information of the newly added game card on the game desktop is a certain specific region to which a location of the newly added game card belongs.

The allocation sequence information of the newly added game card in the game is the number of game cards in the specific region when the newly added game card is in the target state in which allocation ends. The specific region is a region where the game card in the target state in which allocation ends is located, or a region where some game cards in the target state in which allocation ends are located.

For example, when the newly added game card is in the target state in which allocation ends, the newly added game card is located in a game region (that is, the specific region) of the player 1. In this case, the number of the game cards included in the game region of the player 1 is 3, and the allocation sequence information of the newly added game card is 3.

The game identifier information includes information capable of identifying the newly added game card, such as a pattern or a figure, for example, the game identifier information is heart 2 or club 10.

At step 104, whether a sequence of allocating the newly added game card conforms to a predetermined dealing sequence is determined based on the game information.

In the embodiments of the present disclosure, it is assumed that the predetermined dealing sequence includes a specified allocation sequence of regions corresponding to different game players, and is specifically: cards are first dealt to the player 1 and a player 2, then a card is dealt to the player 1, and then a card is dealt to the player 2. A specified region where the newly added game card should be located is the game region of the player 1. Based on the game location information in the game information, the newly added game card is in the game region of the

player 1, and it can be determined that the sequence of the newly added game card conforms to the predetermined dealing sequence.

For another example, the predetermined dealing sequence is that cards are first dealt to the player 1 and the player 2, then a card is dealt to the player 1, and then a card is dealt to the player 2. If it is determined, based on a specified allocation sequence of regions corresponding to different game players, that a specified region where the newly added game card should be located is the game region of the player 1, and a region to which a location of the newly added game card belongs is the game region of the player 1, it can be determined that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

For another example, the predetermined dealing sequence is that cards are first dealt to the player 1 and the player 2, then a card is dealt to the player 1, and then a card is dealt to the player 2. If a figure in the hand of any player does not exceed a preset sum of figure corresponding to the game, a game card may still be allocated to the player, and based on a specified allocation sequence of regions corresponding to different game players, it is determined that a specified region where the newly added game card should be located is the game region of the player 2, and a region to which a location of the newly added game card belongs is the game region of the player 2. Game cards except the newly added game card is in the game region of the player 2 are respectively heart 4 and spade 4, and a preset sum of figure is 10, and in this case, it can be determined that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

If it is determined that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence, dealing may be continued. If it is determined that the sequence of allocating the newly added game card does not conform to the predetermined dealing sequence, a prompt or a warning may be sent to a game controller, so as to automatically detect whether a dealing sequence satisfies the predetermined dealing sequence, thereby reducing man-made allocation errors, and improving intelligence of a game process.

In some optional embodiments, to subsequently accurately determine a time point at which the newly added game card is in the target state, the video stream at step 101 may include video streams at multiple views that are synchronously collected on the game desktop. Optionally, the multiple views may include a side view and an overhead view. The side view includes a left view and/or a right view.

For example, as shown in FIG. 3, a video stream at the left view is obtained by using a camera on the left, a video stream at the right view is obtained by using a camera on the right, and a video

stream at the overhead view is obtained by using a camera at the middle.

Correspondingly, at step 102, when determining whether the newly added game card is in the target state, if a newly added game card is detected in at least one image frame of a video stream corresponding to any one of the multiple views, it is determined that the newly added game card is in the target state in which allocation ends. It is determined that it is detected in the video stream corresponding to a current view that the newly added game card is in a first image frame in the target state in which allocation ends. In video streams collected synchronously at other views, a synchronization image that is collected synchronously with the first image frame is determined. If it is detected in at least one image frame in the first N image frames of the synchronization images that the newly added game card is in the target state in which allocation ends, a time point at which the image of the newly added game card is first detected in the first N image frames of the synchronization image is taken as a time point at which the newly added game card is in the target state in which allocation ends.

If it is detected in none of the first N image frames of the synchronization image that the newly added game card is in the target state, a time point corresponding to the first image frame is taken as the time point at which the newly added game card is in the target state.

In the embodiments of the present disclosure, N is determined based on an average duration of one game, an average duration of each game progress stage, and a sampling frequency of an image, so as to ensure that N image frames that precede the synchronization image are in a same game. N is greater than or equal to 1 and less than or equal to 30.

The foregoing is merely an example for describing a value range of N, and the value of N may be limited in the same game, and is limited based on the game time, which is not limited in the present disclosure.

It is assumed that the first image frame at the left view is an image a, and a synchronization image collected synchronously with the image a at the overhead view is an image b. However, if it is determined, in at least one image frame of first N image frames of the image b, that a newly added game card is in a target state in which allocation ends, it is considered that, in a period of time before the image a is collected, the newly added game card is shielded in the left view, and in this case, a determined earliest time point at which it is determined from an image collected from the left view in the present game that the newly added game card is in the target state in which allocation ends is incorrect. In this case, a time point corresponding to an image in which it is first determined from the first N image frames of the image b in the image collected from the overhead

view that the newly added game card is in the target state is taken as a time point in which the newly added game card is in the target state in which allocation ends.

If a video stream collected from three or more views is obtained, a synchronization image of the first image frame needs to be found in each view, and after determining that it may be detected in at least one image in first N image frames of the synchronization image at each view that a newly added game card is in a target state in which allocation ends, each time point at which it is first detected from the first N image frames of the synchronization image at each view that the newly added game card is in the target state in which allocation ends, the earliest time point is found from the time points, and the earliest time point is taken as a time point at which the newly added game card is in the target state in which allocation ends. Therefore, the time point at which that the newly added game card is in the target state in which allocation ends is determined based on the video stream collected from multiple views is more accurate than a time point at which that the newly added game card is in the target state in which allocation ends is determined based on a video stream collected from a single view.

Further, after the time point at which the newly added game card is in the target state is accurately determined, game information corresponding to the newly added game card is more accurately determined based on an image corresponding to the time point, and finally, accuracy of determining whether a sequence of allocating the newly added game card conforms to a predetermined dealing sequence is improved. In some optional embodiments, the step of performing game card detection on multiple image frames included in the video stream in step 101 includes:

inputting each image frame in the video stream into a detection neural network to obtain an object detection result output by the object detection neural network.

In the embodiments of the present disclosure, the object detection neural network is established in advance, and the object detection neural network is a Faster Region Proposal Networks Convolutional Neural Network (RCNN). In a training process, multiple sample image frames with labels are taken as input values, and an output value is an object detection result of each sample image frame. Based on true values (determined by the labels) of different objects on the multiple sample image frames, network parameters of the Faster RCNN are adjusted, so that a loss value is the smallest, and an object detection model is established. Objects that may be detected by the object detection neural network include, but are not limited to, at least one of a game card, a game player, a game chip, or a game currency.

In the embodiments of the present disclosure, after a video stream collected synchronously from multiple views of the game desktop is obtained, each image frame in the video stream is input into the trained object detection neural network, and the object detection neural network outputs an object detection result. The object detection result indicates whether each image frame in the video stream includes a game card, and a location of the game card in an image that includes the game card.

In the embodiments of the present disclosure, to determine a dealing sequence, the location of the game card is marked by a bounding box in the image that includes the game card in the video stream, for example, as shown in FIG. 4.

In the foregoing embodiments, each image frame in the video stream is input to the object detection neural network, to determine whether each image frame in the video stream output by the object detection neural network includes a game card and a location of the game card in an image that includes the game card, so that the availability is high.

In some optional embodiments, by using the aforementioned object detection result, the location of the game card in the image that includes the game card is determined, so that the newly added game card may be directly determined. For example, if no game card is included in previous multiple image frames, and one game card appears in consecutive multiple image frames starting from a specific image frame, it is determined that the game card is the newly added game card. Alternatively, if previous multiple image frames include a game card, the number of included game cards is 2, and the number of game cards included in multiple consecutive image frames starting from a specific image is 3, it is also determined that there is a newly added game card.

Further, as shown in FIG. 5, a process of determining whether the newly added game card is in a target state in which allocation ends in step 102 includes the following steps.

At step 102-1, among the predetermined number of image frames that include the newly added game card, a distance between locations of the newly added game card in any two image frames among the predetermined number of image frames is determined.

In the embodiments of the present disclosure, among the predetermined number of image frames that include the newly added game card, the distance between the locations of the newly added game card in any two image frames among the predetermined number of image frames is determined.

To improve accuracy of determining whether the newly added game card is in the target state, the predetermined number is a positive integer greater than or equal to 3. For example, the

predetermined number of image frames includes the Nth frame to the $(N+4)^{th}$ frame. In the embodiments of the present disclosure, a Kalman filtering algorithm is used to perform target tracking on the newly added game card, to determine the distance between the locations of the newly added game card in any two image frames among the predetermined number of image frames.

At step 102-2, whether the distance between the locations satisfies a predetermined distance condition is determined.

In the embodiments of the present disclosure, whether an overlapping degree between the locations of the newly added game card in any two image frames is greater than a predetermined value is detected, to determine whether the predetermined distance condition is satisfied.

At step 102-3, under the condition that the distance satisfies the predetermined distance condition, it is determined that the newly added game card is in the target state in which allocation ends.

In the embodiments of the present disclosure, if an overlapping degree of corresponding bounding boxes of the newly added game card in any two image frames among the predetermined number of image frames is greater than a predetermined value, it is determined that the predetermined distance condition is satisfied, and it is determined that the newly added game card has been allocated and is in the target state in which allocation ends.

In the foregoing embodiments, the Kalman filtering algorithm is used to perform target tracking on the newly added game card, and the distance between the locations of the newly added game card in any two image frames is determined among the predetermined number of image frames that include the newly added game card. Under the condition that the distance satisfies the predetermined distance condition, it is determined that the newly added game card is in the target state in which allocation ends. After the newly added game card is in the target state in which allocation ends, that is, after the newly added game card no longer moves, dealing sequence detection is performed, thereby improving the accuracy of the dealing sequence detection.

In some optional embodiments, the Kalman filtering algorithm has a basic assumption when being applied to single target tracking: both errors between an alternative detected value and a real value and between a predicted value and the real value conform to Gaussian distribution. Therefore, impact from the errors needs to be considered during calculation of both an observed value and the predicted value.

At an initialization phase of the algorithm, two parameter matrices are provided: a location

matrix X in a target geometric center, where X is a 1×2 matrix, and a covariance matrix P, where P is a 2×2 matrix. In addition, there is a matrix Q used to measure an error of the covariance matrix, and Q is also a 2×2 matrix. For a game card, X is obtained based on a detection result of the game card, and corresponds to a detected value of center location coordinates of a bounding box of the game card in a current frame, P is a super parameter directly calculated based on X, and Q is a manually specified super parameter.

When a current image frame is the nth image frame, center location coordinates of X_n in the bounding box of the game card detected in the nth image frame are denoted as a detected value. P_n is a covariance matrix that is calculated based on X_n in the current image frame.

In the embodiments of the present disclosure, center location coordinates of a bounding box of a game card in a next frame, that is, the $(n+1)^{th}$ image frame, of the current frame are X_{n+1}, and a corresponding covariance matrix is P_{n+1}. Values of X_{n+1} and P_{n+1} are considered in two cases:

In the first case, a location of the game card in the $(n+1)^{th}$ image frame remains still relative to a location of the game card in the nth image frame, that is, the center location of the bounding box corresponding to the game card remains unchanged in the two image frames. In this case, $X_{n+1}=X_n$, and the covariance matrix $P_{n+1}=P_n+Q$.

In the second case, the location of the game card in the $(n+1)^{th}$ image frame changes relative to the location of the game card in the nth image frame.

In the embodiments of the present disclosure, the location of the game card in the $(n+1)^{th}$ image frame is predicted at least based on a change trajectory of the location of the game card in the $(n+1)^{th}$ image frame and the location of the game card in the nth image frame, to obtain X_{n+1}'. In this case, X_{n+1}' is a predicted value, and an error may exist. Therefore, actual detection is performed on the center location of the bounding box corresponding to the game card in the $(n+1)^{th}$ image frame, X_{n+1}' is modified with the obtained detected value, and X_{n+1} and P_{n+1} are finally obtained.

The detected value is obtained by detecting the center location of the bounding box corresponding to the game card in the $(n+1)^{th}$ image frame. An error may exist in the detected value, the error may be R, and R is also a manually predetermined super parameter. The alternative detected value is corrected with R, to obtain a corrected detected value X_{n+1}''.

Currently, there are two Gaussian distributions: one is the predicted value X_{n+1}', and the other is the detected value X_{n+1}'' corrected with the error R in the $(n+1)^{th}$ image frame. A difference between X_{n+1}'' and X_{n+1}' is multiplied by X_{n+1}' to obtain a new distribution. A new distribution

mean and a new distribution covariance may be obtained through mathematical calculation, the new distribution mean is taken as X_{n+1}, and the new distribution covariance is taken as P_{n+1}. Where, X_{n+1} is center location coordinates of the bounding box of the game card in the nth image frame.

In the embodiments of the present disclosure, the Kalman filtering algorithm is used to determine respectively the location of each game card in each image frame among the predetermined number of image frames that include the newly added game card, and then bipartite graph matching is performed to determine locations of the newly added game card in any two image frames, so as to determine a distance between the locations of the newly added game card in any two image frames.

When the Kalman filtering algorithm is used, the observed value is a center location of a bounding box corresponding to each game card in the current image frame, and the predicted value X_{n+1}' is coordinates of the center location of the bounding box, in the next image frame, of each game card predicted based on the current image frame and at least one previous image frame. The detected value is obtained by detecting the next image frame of the current frame. The detected value is coordinates of a center location of a bounding box corresponding to each game card in the next image frame of the current frame. The alternative detected value is corrected with a predetermined error R, to obtain a corrected detected value X_{n+1}'' corresponding to each game card in the next image frame of the current frame. After the predicted value X_{n+1}' and the corrected detected value X_{n+1}'' are obtained, X_{n+1} and P_{n+1} are calculated in the aforementioned manner, where X_{n+1} is coordinates of the center location of the bounding box corresponding to each game card in the next image frame, and the location of the bounding box corresponding to each game card in the next image frame is determined based on P_{n+1} and X_{n+1}. Further, a matching algorithm is used for the current image frame and the next image frame, and a bounding box corresponding to each game card included in the current image frame and a bounding box corresponding to each game card included in the next image frame are matched one by one, so that after a location of a bounding box corresponding to the newly added game card is determined in each image frame, a distance between locations of the newly added game card in any two image frames can be determined.

For example, as shown in FIG. 6, step 102-1 includes the following steps.

At step 102-11, in at least two adjacent image frames among the predetermined number of image frames, a motion trajectory of each game card included in the at least two adjacent image frames is determined respectively.

In the embodiments of the present disclosure, the motion trajectory of each game card included in the at least two adjacent image frames is first determined based on the at least two adjacent image frames among the predetermined number of image frames, where the at least two image frames include the current image frame and at least one previous image frame.

For example, the current image frame and the at least one previous image frame include three game cards, where a game card 3 is a newly added game card, and respective locations of the game cards 1, 2, and 3 in the previous image frame and the current image frame are shown in FIG. 7A. Coordinates of the center location of the bounding box corresponding to each game card in the current image frame are X_n.

At step 102-12, the predicted location of each game card in the next image frame that is adjacent to the current image frame is predicted based on the motion trajectory of each game card in the at least two adjacent image frames.

In the embodiments of the present disclosure, the center location of the bounding box of each game card in the next image frame is predicted based on the motion trajectory of each game card in the at least two adjacent image frames. For example, as shown in FIG. 7B, locations of the game cards 1 and 2 remain unchanged, and the location of the game card 3 is moved rightward. In this case, the predicted location X_{n+1}' is obtained.

At step 102-13, the detected location of each game card included in the next image frame is obtained.

In the embodiments of the present disclosure, the detected location of each game card in the next image frame is a detected location corresponding to each game card output by the object detection neural network after the next image frame is input into the object detection neural network. The corrected detected location X_{n+1}'' of each game card included in the next image frame is obtained by modifying each detected location with a predetermined error R.

After the predicted location X_{n+1}' and the corrected detected location X_{n+1}'' are obtained, X_{n+1} and P_{n+1} are calculated. The location of the bounding box corresponding to each game card included in the next image frame is determined based on X_{n+1} and P_{n+1}.

By using the aforementioned process, iterative calculation is performed, so that subsequent update may be continued to obtain X_{n+2} and P_{n+2}, ..., and X_{n+m} and P_{n+m}.

It should be noted here that the location of the bounding box corresponding to each included game card is identified in the next image frame, but the game card corresponding to each location

cannot be determined, and the location of each game card needs to be subsequently determined through matching.

At step 102-14, the predicted location is matched with the detected location to determine a location of the newly added game card in the next image frame.

In the embodiments of the present disclosure, a bipartite graph matching algorithm is used to match the predicted location with the detected location. Bipartite graph matching is to divide all edges in two graphs into a set of multiple points, and any two points in the two graphs are matched to obtain a group of matching results that all points in one graph are matched one by one with all points in the other graph. This process is a bipartite graph matching process.

In the embodiments of the present disclosure, bipartite graph matching is performed on the predicted location and the detected location, so that all points included in at least one edge of a bounding box corresponding to each predicted game card are in one-to-one correspondence to all points included in at least one edge of a bounding box corresponding to each game card in the next image frame. Therefore, a specific location corresponding to each game card is determined in the next image frame, so as to obtain the location of the newly added game card in the next image frame.

For example, the predicted location of each game card included in the next image frame is shown in FIG. 7B, and the detected location of each game card included in the next image frame is shown in FIG. 7C. After bipartite graph matching, it is determined that there are a game card 1, a game card 3, and a game card 2 from left to right in the next image frame. It is assumed that the game card 3 is a newly added game card, and a location of a bounding box in the middle is the location of the newly added game card.

At step 102-15, the distance between the locations of the newly added game card in any two image frames among the predetermined number of image frames is determined based on the locations of the newly added game card in any two image frames among the predetermined number of image frames.

In the embodiments of the present disclosure, the location of the bounding box corresponding to the newly added game card is determined in any two image frames among the predetermined number of image frames, to determine the distance between the locations of the newly added game card in the any two image frames. In the foregoing embodiments, the Kalman filtering algorithm is used to track a game card, and then, the location of the newly added game card in the next image frame is determined by using a matching algorithm of bipartite graph. Then, the distance between

the locations of the newly added game card in any two image frames among the predetermined number of image frames is determined based on the locations of the newly added game card in any two image frames among the predetermined number of image frames. Therefore, the objective of automatically tracking the newly added game card is achieved, thereby facilitating subsequent determination of whether the newly added game card is in the target state in which allocation ends.

In some optional embodiments, for example, as shown in FIG. 8, step 102-2 may include the following steps.

At step 102-21, a first area of an overlapping part of target bounding boxes of the newly added game card in any two image frames among the predetermined number of image frames is determined, and a second area occupied by the target bounding boxes of the newly added game card in any two image frames among the predetermined number of image frames other than the first area is determined.

For example, as shown in FIG. 9, two image frames are overlapped, so that an area of an overlapping part between the target bounding boxes corresponding to the newly added game card is determined as the first area. Other than the first area, a sum of other areas occupied by the target bounding boxes corresponding to the newly added game card is the second area.

At step 102-22, a sum of the first area and the second area is taken as a third area.

The sum of the first area and the second area is the third area.

At step 102-23, if a quotient of the first area and the third area is greater than a predetermined value, it is determined that the distance between the locations of the newly added game card in any two image frames among the predetermined number of image frames satisfies the predetermined distance condition.

A larger quotient of the first area and the third area indicates a larger overlapping part between the target bounding boxes corresponding to the newly added game card in two image frames, that is, if the central locations of the target bounding boxes are closer, it is determined that the distance between the locations of the newly added game card in any two image frames among the predetermined number of image frames satisfies the predetermined distance condition.

In the previous embodiments, Intersection over Union (IOU) continuous detection is performed on a distance between target bounding boxes corresponding to the newly added game card in any two image frames among the predetermined number of image frames, to determine the overlapping degree of the target bounding boxes. If the overlapping degree is greater than the

predetermined value, it is determined that the newly added game card is in the target state in which allocation ends, so that the availability is high.

In some optional embodiments, the game information includes the game location information of the newly added game card on the game desktop, and step 103 includes:

taking, based on a location of the newly added game card in at least one image frame when the newly added game card is in the target state in which allocation ends, and on regions that are divided on the game desktop in advance and correspond to different game players, a region of a game player to which the location of the newly added game card belongs as the game location information of the newly added game card on the game desktop.

In the embodiments of the present disclosure, at least one image frame when the newly added game card is in the target state is captured from the video stream synchronously collected from multiple views of the game desktop.

At step 103-11, a region of a game player to which the location of the newly added game card belongs is taken as the game location information of the newly added game card on the game desktop based on the location of the newly added game card and regions that are divided on the game desktop in advance and correspond to different game players.

For example, the regions corresponding to different game players are divided on the game desktop in advance. It is assumed that the left half of the game desktop is a region of the game player 1, and the right half is a region of the game player 2. If the newly added game card is on a left side of the game desktop, it is determined that the game location information of the newly added game card on the game desktop is the region of the game player 1.

Correspondingly, as shown in FIG. 10, step 104 includes the following steps.

At step 104-11, a specified region where the newly added game card should be located is determined based on a specified allocation sequence of regions corresponding to different game players.

For example, if an allocation sequence is specified as the game player 1, the game player 2, the game player 1, and the game player 2, and the specified allocation sequence corresponding to the newly added game card is 3, it is determined that the specified region where the newly added game card should be located is the region of the game player 1.

At step 104-12, under the condition that a region of the game player to which the location of the newly added game card belongs is consistent with the specified region, and a total number of

game cards currently included in the area of the game player to which the location of the newly added game card belongs is less than or equal to a first predetermined value, it is determined that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

The first predetermined value is determined according to a game rule, for example, the first predetermined value is an upper limit value of a game card allocated to each player.

For example, the region of the player to which the location of the newly added game card belongs is the region of the player 1, the specified region is also the region of the player 1, and the two are consistent with each other. In addition, under the condition that the number of the game cards currently included in the region of the game player to which the location of the newly added game card belongs is 2, and the first predetermined value is also 2, it is determined that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

In the foregoing embodiments, when the game information includes the game location information of the newly added game card on the game desktop, whether the sequence of allocating the newly added game card conforms to the predetermined dealing sequence is determined, thereby achieving an objective of automatically detecting a dealing sequence, and improving game intelligence.

In some optional embodiments, the game information includes the allocation sequence information of the newly added game card in the game, and for example, as shown in FIG. 11, step 103 includes the following steps.

At step 103-21, the number of the game cards in the target region when the newly added game card is in the target state in which allocation ends is determined.

The target region is a region where game cards in the target state in which allocation ends are located on the game desktop. For example, one region for allocating game cards is separately divided on the game desktop, and each game card is placed in the region after allocation ends. In the embodiments of the present disclosure, the number of all the game cards in the target region is determined.

At step 103-22, the number of the game cards in the target region is taken as the allocation sequence information of the newly added game card in the game.

For example, under the condition that the number of the game cards in the target region is 4, the allocation sequence information of the newly added game card in the game is also 4.

Correspondingly, as shown in FIG. 12, step 104 includes the following steps.

At step 104-21, whether the number of the game cards in the target region is less than or equal to a second predetermined value is determined.

The second predetermined value is determined according to a game rule, for example, the second predetermined value is an upper limit value of a game card in the target region.

In the embodiments of the present disclosure, whether the allocation sequence information of the newly added game card in the game may be determined, that is, the number of the game cards in the target region is less than or equal to the second predetermined value.

At step 104-22, under the condition that the number of the game cards in the target region is less than or equal to the second predetermined value, it is determined that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

For example, if the second predetermined value is 5 and the number of game cards in the target region is 4, it is determined that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

In the foregoing embodiments, if the game information includes the allocation sequence information of the newly added game card in the game, it is determined that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence, thereby achieving the objective of automatically detecting a dealing sequence, and improving game intelligence.

In some optional embodiments, the game information includes the game identifier information of the newly added game card and the allocation sequence information of the newly added game card in the game, and for example, as shown in FIG. 13, step 103 includes the following steps.

At step 103-31, a figure of the newly added game card is determined based on at least one image frame that includes the newly added game card.

In the embodiments of the present disclosure, the at least one image frame that includes the newly added game card may be at least one image frame when it is determined that the newly added game card is in the target state in which allocation ends, and/or at least one image frame before a next newly added game card appears after the newly added game card is in the target state in which allocation ends.

The at least one image frame that includes the newly added game card is input into a game identifier recognition neural network to obtain the figure of the newly added game card that is

output by the game identifier recognition neural network. The figure is the game identifier information of the newly added game card.

In the game identifier recognition neural network, a deep neural network such as resnet 18 (residual network 18) may be used as a backbone network. During training of the backbone network, multiple sample images with labels are used. Each sample image includes identifier information of a game card, for example, a pattern and a figure. Network parameter of the backbone network are adjusted, so as to minimize an identification result output by the backbone network and a loss value of an identification result marked in the sample image, thereby obtaining the game identifier recognition neural network.

At step 103-32, the number of the game cards in the target region when the newly added game card is in the target state in which allocation ends is determined.

In the embodiments of the present disclosure, the target region is a region where game cards in the target state in which allocation ends are located on the game desktop. In this case, the number of all the game cards included in the target region is determined.

At step 103-33, the number of the game cards in the target region is taken as the allocation sequence information of the newly added game card in the game.

In the embodiments of the present disclosure, the allocation sequence information of the newly added game card in the game is the number of all the game cards included in the target region.

After the game identifier information of the newly added game card and the allocation sequence information of the newly added game card in the game are determined, correspondingly, for example, as shown in FIG. 14, step 104 includes the following steps.

At step 104-31, a sum of figure of all the game cards except the newly added game card in the target region is determined.

In the embodiments of the present disclosure, it is further necessary to determine the sum of figure of all the game cards except the newly added game card in the target region.

At step 104-32, under the condition that the number of the game cards in the target region is greater than or equal to a second predetermined value and less than a third predetermined value, and the sum of figure does not exceed a preset sum of figure, it is determined that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

The third predetermined value is determined according to a game rule, for example, the third predetermined value is an upper limit value of a game card when a game player wins in a current

game.

In the embodiments of the present disclosure, for example, the second predetermined value is 5, the third predetermined value is 6, and the number of game cards in the target region is 5. In this case, it is directly determined that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence. Then, the sum of figure of five game cards in the target region is calculated. It is assumed that the sum of figure of the five game cards in the target region is 18, and the preset sum of figure is 21, it is determined that the game card may be further allocated.

In the foregoing embodiments, if the game information includes the game identifier information of the newly added game card and the allocation sequence information of the newly added game card in the game, it is determined that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence, thereby achieving the objective of automatically detecting a dealing sequence is implemented, and improving game intelligence.

In some optional embodiments, dealing sequence detection may be automatically performed in a smart casino in the aforementioned manner. Taking Baccarat as an example, all game cards in the target state in which allocation ends are in the target region. Therefore, by detecting the newly added game card in the target region, whether the sequence of allocating the newly added game card conforms to the predetermined dealing sequence may be determined. It is assumed that the second predetermined value is 5, and the third predetermined value is 6, when the number of the game cards included in the target region is 4, the sequence of allocating the newly added game card conforms to the predetermined dealing sequence. When the number of the game cards included in the target region is 5, the sum of figure of the game cards in the target region needs to be determined. If the sum of figure does not exceed the preset sum of figure, a sixth card is dealt. If the sum of figure exceeds the preset sum of figure, the sixth card is not dealt. Therefore, in the aforementioned manner, a dealing sequence error caused by manual dealing is avoided, and loss is caused to players.

Corresponding to the foregoing method embodiments, the present disclosure further provides apparatus embodiments.

As shown in FIG. 15, which is a block diagram of an apparatus for detecting dealing sequence according to one exemplary embodiment of the present disclosure, the apparatus includes: an execution module 210, configured to: obtain a video stream of a game desktop, and perform game card detection on multiple image frames included in the video stream; a first determining module 220, configured to: in response to detecting a newly added game card in at least one image frame

in the video stream, determine whether the newly added game card is in a target state in which allocation ends; a second determining module 230, configured to: after the newly added game card is in the target state in which allocation ends, determine game information corresponding to the newly added game card; and a third determining module 240, configured to determine, based on the game information, whether a sequence of allocating the newly added game card conforms to a predetermined dealing sequence.

In some optional embodiments, the execution module is configured to input each image frame in the video stream into an object detection neural network to obtain an object detection result output by the object detection neural network, where the object detection result at least includes whether each image frame in the video stream includes a game card and a location of a game card in an image that includes the game card.

In some optional embodiments, the first determining module includes: a first determining sub-module, configured to determine, in a predetermined number of image frames that include the newly added game card, a distance between locations of the newly added game card in any two image frames among the predetermined number of image frames; a second determining sub-module, configured to determine whether the distance between the locations satisfies a predetermined distance condition; and a third determining sub-module, configured to: under the condition that the distance satisfies the predetermined distance condition, determine that the newly added game card is in the target state in which allocation ends.

In some optional embodiments, the first determining sub-module includes: a first determining unit, configured to determine respectively, in at least two adjacent image frames among the predetermined number of image frames, a motion trajectory of each game card included in the at least two adjacent image frames, where the at least two adjacent image frames include a current image frame and a previous image frame that is adjacent to the current image frame; a predicting unit, configured to predict, based on the motion trajectory of each game card in the at least two adjacent image frames, a predicted location of each game card in a next image frame that is adjacent to the current image frame; an obtaining unit, configured to obtain a detected location of each game card included in the next image frame; a second determining unit, configured to match the predicted location with the detected location to determine a location of the newly added game card in the next image frame; and a third determining unit, configured to determine the distance between the locations of the newly added game card in any two image frames among the predetermined number of image frames based on the locations of the newly added game card in any two image frames among the predetermined number of image frames.

In some optional embodiments, the second determining sub-module includes: a fourth determining unit, configured to determine a first area of an overlapping part of target bounding boxes of the newly added game card in any two image frames among the predetermined number of image frames, and a second area occupied by the target bounding boxes of the newly added game card in any two image frames among the predetermined number of image frames other than the first area; a fifth determining unit, configured to take a sum of the first area and the second area as a third area; and a sixth determining unit, configured to: if a quotient of the first area and the third area is greater than a predetermined value, determine that the distance between the locations of the newly added game card in any two image frames among the predetermined number of image frames satisfies the predetermined distance condition.

In some optional embodiments, the game information corresponding to the newly added game card includes at least one of the following: game location information of the newly added game card on the game desktop, allocation sequence information of the newly added game card in a game, or game identifier information of the newly added game card, where the game identifier information includes at least one of a pattern or a figure.

In some optional embodiments, the game information includes the game location information of the newly added game card on the game desktop, and the second determining module includes: a fourth determining sub-module, configured to take, based on a location of the newly added game card in at least one image frame when the newly added game card is in the target state in which allocation ends, and on regions that are divided on the game desktop in advance and correspond to different game players, a region of a game player to which the location of the newly added game card belongs as the game location information of the newly added game card on the game desktop; and the third determining module includes: a fifth determining sub-module, configured to determine, based on a specified allocation sequence of regions corresponding to different game players, a specified region where the newly added game card should be located; and a sixth determining sub-module, configured to: under the condition that the region of the game player to which the location of the newly added game card belongs is consistent with the specified region, and a total number of game cards currently included in the region of the game player to which the location of the newly added game card belongs is less than or equal to a first predetermined value, determine that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

In some optional embodiments, the game information includes the allocation sequence information of the newly added game card in the game, and the second determining module

includes: a seventh determining sub-module, configured to determine the number of game cards in a target region when the newly added game card is in the target state in which allocation ends, where the target region is a region where game cards in the target state in which allocation ends on the game desktop are located; and an eighth determining sub-module, configured to take the number of the game cards in the target region as the allocation sequence information of the newly added game card in the game; and the third determining module includes: a ninth determining sub-module, configured to determine whether the number of the game cards in the target region is less than or equal to a second predetermined value; and a tenth determining sub-module, configured to: under the condition that the number of the game cards in the target region is less than or equal to the second predetermined value, determine that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

In some optional embodiments, the game information includes the game identifier information of the newly added game card and the allocation sequence information of the newly added game card in the game, and the second determining module includes: an eleventh determining sub-module, configured to determine a figure of the newly added game card based on at least one image frame that includes the newly added game card; a twelfth determining sub-module, configured to determine the number of game cards in a target region when the newly added game card is in the target state in which allocation ends, where the target region is a region where game cards in the target state in which allocation ends on the game desktop are located; and a thirteenth determining sub-module, configured to take the number of the game cards in the target region as the allocation sequence information of the newly added game card in the game; and the third determining module includes: a fourteenth determining sub-module, configured to determine a sum of figure of all the game cards except the newly added game card in the target region; and a fifteenth determining sub-module, configured to: under the condition that the number of the game cards in the target region is greater than or equal to a second predetermined value and less than a third predetermined value, and the sum of figure does not exceed a preset sum of figure, determine that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

Because the apparatus embodiments basically correspond to the method embodiments, for related parts, reference may be made to a part of the description in the method embodiments. The apparatus embodiments described above are merely exemplary. The units described as separate parts may or may not be physically separate, and parts displayed as units may or may not be physical units, i.e., may be located in one position, or may be distributed on a plurality of network

units. Some or all of the modules may be selected according to actual requirements to achieve the objectives of the solutions of the present disclosure. A person of ordinary skill in the art may understand and implement the embodiments of the present invention without involving creative efforts.

The embodiments of the present disclosure further provide a computer-readable storage medium, where the storage medium stores a computer program, and the computer program is configured to perform the method for detecting dealing sequence according to in any one of the foregoing items.

In some optional embodiments, the embodiments of the present disclosure provide a computer program product, including a computer readable code. When the computer readable code runs on a device, a processor in the device executes instructions for implementing the method for detecting dealing sequence provided in any one of the foregoing embodiments.

In some optional embodiments, the embodiments of the present disclosure further provide another computer program product, configured to store computer-readable instructions. When the instructions are executed, a computer performs operations of the method for detecting dealing sequence provided in any one of the previous embodiments.

The computer program product is specifically implemented by hardware, software, or a combination thereof. In one optional embodiment, the computer program product is specifically embodied as a computer storage medium. In another optional embodiment, the computer program product is specifically embodied as a software product, such as a Software Development Kit (SDK).

The embodiments of the present disclosure further provide an electronic device, including:

a processor; and

a memory configured to store instructions executable by the processor.

The processor is configured to invoke the executable instructions stored in the memory to implement the method for detecting dealing sequence according to any one of the foregoing items.

FIG. 16 is a schematic structural diagram of hardware of an electronic device for detecting dealing sequence according to the embodiments of the present application. The electronic device 310 includes a processor 311, and further includes an input apparatus 312, an output apparatus 313, and a memory 314. The input apparatus 312, the output apparatus 313, the memory 314, and the processor 311 are connected by means of a bus.

The memory includes, but is not limited to, a Random Access Memory (RAM), a Read-Only

Memory (ROM), an Erasable Programmable Read Only Memory (EPROM), or a Compact Disc Read-Only Memory (CD-ROM), and the memory is configured to store related instructions and data.

The input apparatus is configured to input data and/or a signal, and the output apparatus is configured to output data and/or a signal. The output apparatus and the input apparatus may be independent components, or can be an integrated component.

The processor may include one or more processors, for example, include one or more Central Processing Units (CPU). When the processor is one CPU, the CPU is a single-core CPU, or may be a multi-core CPU.

The memory is configured to store program code and data of a network device.

The processor is configured to invoke the program code and the data in the memory to perform the steps in the foregoing method embodiments. For details, refer to the descriptions in the foregoing method embodiments. Details are not described here.

It may be understood that FIG. 16 shows only simplified design of an electronic device for detecting dealing sequence. In actual applications, the electronic device for detecting dealing sequence may further include other necessary elements, including, but not limited to, any number of input/output apparatuses, processors, controllers, memories, and the like, and all apparatuses for detecting dealing sequence that can implement the embodiments of the present application fall within the protection scope of the present application.

A person skilled in the art can easily figure out other implementation solutions of the present disclosure after considering the specification and practicing the invention disclosed here. The present disclosure is intended to cover any variations, functions, or adaptive changes of the present disclosure. These variations, functions, or adaptive changes comply with general principles of the present disclosure, and include common knowledge or a commonly used technical means in the technical field that is not disclosed in the present disclosure. The specification and the embodiments are merely considered to be exemplary, and the actual scope and spirit of the present disclosure are pointed out by the following claims.

The above descriptions are merely preferred exemplary embodiments of the present disclosure, but are not intended to limit the present disclosure. Any modification, equivalent replacement, or improvement made without departing from the spirit and principle of the present disclosure shall fall within the protection scope of the present disclosure.

CLAIMS

1. A method for detecting dealing sequence, comprising:

obtaining a video stream of a game desktop, and performing game card detection on multiple image frames included in the video stream;

in response to detecting a newly added game card in at least one image frame in the video stream, determining whether the newly added game card is in a target state in which allocation ends;

after the newly added game card is in the target state in which allocation ends, determining game information corresponding to the newly added game card; and

determining, based on the game information, whether a sequence of allocating the newly added game card conforms to a predetermined dealing sequence.

2. The method according to claim 1, wherein the performing game card detection on multiple image frames included in the video stream comprises:

inputting each image frame in the video stream into an object detection neural network to obtain an object detection result output by the object detection neural network, wherein the object detection result at least comprises whether each image frame in the video stream comprises a game card and a location of a game card in an image that comprises the game card.

3. The method according to claim 1 or 2, wherein the determining whether the newly added game card is in a target state in which allocation ends comprises:

determining, in a predetermined number of image frames that comprise the newly added game card, a distance between locations of the newly added game card in any two image frames among the predetermined number of image frames;

determining whether the distance between the locations satisfies a predetermined distance condition; and

under the condition that the distance satisfies the predetermined distance condition, determining that the newly added game card is in the target state in which allocation ends.

4. The method according to claim 3, wherein the determining, in a predetermined number of image frames that comprise the newly added game card, a distance between locations of the newly

added game card in any two image frames among the predetermined number of image frames comprises:

determining respectively, in at least two adjacent image frames among the predetermined number of image frames, a motion trajectory of each game card included in the at least two adjacent image frames, wherein the at least two adjacent image frames comprise a current image frame and a previous image frame that is adjacent to the current image frame;

predicting, based on the motion trajectory of each game card in the at least two adjacent image frames, a predicted location of each game card in a next image frame that is adjacent to the current image frame;

obtaining a detected location of each game card included in the next image frame;

matching the predicted location with the detected location to determine a location of the newly added game card in the next image frame; and

determining the distance between the locations of the newly added game card in any two image frames among the predetermined number of image frames based on the locations of the newly added game card in any two image frames among the predetermined number of image frames.

5. The method according to claim 3 or 4, wherein the determining whether the distance between the locations satisfies a predetermined distance condition comprises:

determining a first area of an overlapping part of target bounding boxes of the newly added game card in any two image frames among the predetermined number of image frames, and a second area occupied by the target bounding boxes of the newly added game card in any two image frames among the predetermined number of image frames other than the first area;

taking a sum of the first area and the second area as a third area; and

if a quotient of the first area and the third area is greater than a predetermined value, determining that the distance between the locations of the newly added game card in any two image frames among the predetermined number of image frames satisfies the predetermined distance condition.

6. The method according to any one of claims 1 to 5, wherein the game information corresponding to the newly added game card comprises at least one of the following:

game location information of the newly added game card on the game desktop, allocation

sequence information of the newly added game card in a game, or game identifier information of the newly added game card, wherein the game identifier information comprises at least one of a pattern or a figure.

7. The method according to claim 6, wherein the game information comprises the game location information of the newly added game card on the game desktop, and the determining game information corresponding to the newly added game card comprises:

taking, based on a location of the newly added game card in at least one image frame when the newly added game card is in the target state in which allocation ends, and on regions that are divided on the game desktop in advance and correspond to different game players, a region of a game player to which the location of the newly added game card belongs as the game location information of the newly added game card on the game desktop; and

the determining, based on the game information, whether a sequence of allocating the newly added game card conforms to a predetermined dealing sequence comprises:

determining, based on a specified allocation sequence of regions corresponding to different game players, a specified region where the newly added game card is located; and

under the condition that the region of the game player to which the location of the newly added game card belongs is consistent with the specified region, and a total number of game cards currently included in the region of the game player to which the location of the newly added game card belongs is less than or equal to a first predetermined value, determining that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

8. The method according to claim 6, wherein the game information comprises the allocation sequence information of the newly added game card in the game, and the determining game information corresponding to the newly added game card comprises:

determining the number of game cards in a target region when the newly added game card is in the target state in which allocation ends, wherein the target region is a region where game cards in the target state in which allocation ends on the game desktop are located; and

taking the number of the game cards in the target region as the allocation sequence information of the newly added game card in the game; and

the determining, based on the game information, whether a sequence of allocating the newly added game card conforms to a predetermined dealing sequence comprises:

determining whether the number of the game cards in the target region is less than or equal to a second predetermined value; and

under the condition that the number of the game cards in the target region is less than or equal to the second predetermined value, determining that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

9. The method according to claim 6, wherein the game information comprises the game identifier information of the newly added game card and the allocation sequence information of the newly added game card in the game, and the determining game information corresponding to the newly added game card comprises:

determining a figure of the newly added game card based on at least one image frame that comprises the newly added game card;

determining the number of game cards in a target region when the newly added game card is in the target state in which allocation ends, wherein the target region is a region where game cards in the target state in which allocation ends on the game desktop are located; and

taking the number of the game cards in the target region as the allocation sequence information of the newly added game card in the game; and

the determining, based on the game information, whether a sequence of allocating the newly added game card conforms to a predetermined dealing sequence comprises:

determining a sum of figure of all the game cards except the newly added game card in the target region; and

under the condition that the number of the game cards in the target region is greater than or equal to a second predetermined value and less than a third predetermined value, and the sum of figure does not exceed a preset sum of figure, determining that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

10. An apparatus for detecting dealing sequence, comprising:

an execution module, configured to: obtain a video stream of a game desktop, and perform game card detection on multiple image frames included in the video stream;

a first determining module, configured to: in response to detecting a newly added game card in at least one image frame in the video stream, determine whether the newly added game card is in a target state in which allocation ends;

a second determining module, configured to: after the newly added game card is in the target state in which allocation ends, determine game information corresponding to the newly added game card; and

a third determining module, configured to determine, based on the game information, whether a sequence of allocating the newly added game card conforms to a predetermined dealing sequence.

11. The apparatus according to claim 10, wherein the execution module is configured to:

input each image frame in the video stream into an object detection neural network to obtain an object detection result output by the object detection neural network, wherein the object detection result at least comprises whether each image frame in the video stream comprises a game card and a location of a game card in an image that comprises the game card.

12. The apparatus according to claim 10 or 11, wherein the first determining module comprises:

a first determining sub-module, configured to determine, in a predetermined number of image frames that comprise the newly added game card, a distance between locations of the newly added game card in any two image frames among the predetermined number of image frames;

a second determining sub-module, configured to determine whether the distance between the locations satisfies a predetermined distance condition; and

a third determining sub-module, configured to: under the condition that the distance satisfies the predetermined distance condition, determine that the newly added game card is in the target state in which allocation ends.

13. The apparatus according to claim 12, wherein the first determining sub-module comprises:

a first determining unit, configured to determine respectively, in at least two adjacent image frames among the predetermined number of image frames, a motion trajectory of each game card included in the at least two adjacent image frames, wherein the at least two adjacent image frames comprise a current image frame and a previous image frame that is adjacent to the current image frame;

a predicting unit, configured to predict, based on the motion trajectory of each game card in the at least two adjacent image frames, a predicted location of each game card in a next image frame that is adjacent to the current image frame;

an obtaining unit, configured to obtain a detected location of each game card included in the

next image frame;

a second determining unit, configured to match the predicted location with the detected location to determine a location of the newly added game card in the next image frame; and

a third determining unit, configured to determine the distance between the locations of the newly added game card in any two image frames among the predetermined number of image frames based on the locations of the newly added game card in any two image frames among the predetermined number of image frames.

14. The apparatus according to claim 12 or 13, wherein the second determining sub-module comprises:

a fourth determining unit, configured to determine a first area of an overlapping part of target bounding boxes of the newly added game card in any two image frames among the predetermined number of image frames, and a second area occupied by the target bounding boxes of the newly added game card in any two image frames among the predetermined number of image frames other than the first area;

a fifth determining unit, configured to take a sum of the first area and the second area as a third area; and

a sixth determining unit, configured to: if a quotient of the first area and the third area is greater than a predetermined value, determine that the distance between the locations of the newly added game card in any two image frames among the predetermined number of image frames satisfies the predetermined distance condition.

15. The apparatus according to any one of claims 10 to 14, wherein the game information corresponding to the newly added game card comprises at least one of the following:

game location information of the newly added game card on the game desktop, allocation sequence information of the newly added game card in a game, or game identifier information of the newly added game card, wherein the game identifier information comprises at least one of a pattern or a figure.

16. The apparatus according to claim 15, wherein the game information comprises the game location information of the newly added game card on the game desktop, and the second determining module comprises:

a fourth determining sub-module, configured to take, based on a location of the newly added

game card in at least one image frame when the newly added game card is in the target state in which allocation ends, and on regions that are divided on the game desktop in advance and correspond to different game players, a region of a game player to which the location of the newly added game card belongs as the game location information of the newly added game card on the game desktop; and

the third determining module comprises:

a fifth determining sub-module, configured to determine, based on a specified allocation sequence of regions corresponding to different game players, a specified region where the newly added game card is located; and

a sixth determining sub-module, configured to: under the condition that the region of the game player to which the location of the newly added game card belongs is consistent with the specified region, and a total number of game cards currently included in the region of the game player to which the location of the newly added game card belongs is less than or equal to a first predetermined value, determine that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

17. The apparatus according to claim 15, wherein the game information comprises the allocation sequence information of the newly added game card in the game, and the second determining module comprises:

a seventh determining sub-module, configured to determine the number of game cards in a target region when the newly added game card is in the target state in which allocation ends, wherein the target region is a region where game cards in the target state in which allocation ends on the game desktop are located; and

an eighth determining sub-module, configured to take the number of the game cards in the target region as the allocation sequence information of the newly added game card in the game; and

the third determining module comprises:

a ninth determining sub-module, configured to determine whether the number of the game cards in the target region is less than or equal to a second predetermined value; and

a tenth determining sub-module, configured to: under the condition that the number of the game cards in the target region is less than or equal to the second predetermined value, determine that the sequence of allocating the newly added game card conforms to the predetermined dealing

sequence.

18. The apparatus according to claim 15, wherein the game information comprises the game identifier information of the newly added game card and the allocation sequence information of the newly added game card in the game, and the second determining module comprises:

an eleventh determining sub-module, configured to determine a figure of the newly added game card based on at least one image frame that comprises the newly added game card;

a twelfth determining sub-module, configured to determine the number of game cards in a target region when the newly added game card is in the target state in which allocation ends, wherein the target region is a region where game cards in the target state in which allocation ends on the game desktop are located; and

a thirteenth determining sub-module, configured to take the number of the game cards in the target region as the allocation sequence information of the newly added game card in the game; and

the third determining module comprises:

a fourteenth determining sub-module, configured to determine a sum of figure of all the game cards except the newly added game card in the target region; and

a fifteenth determining sub-module, configured to: under the condition that the number of the game cards in the target region is greater than or equal to a second predetermined value and less than a third predetermined value, and the sum of figure does not exceed a preset sum of figure, determine that the sequence of allocating the newly added game card conforms to the predetermined dealing sequence.

19. A computer-readable storage medium, wherein the storage medium stores a computer program, and the computer program is configured to perform the method for detecting dealing sequence according to any one of claims 1 to 9.

20. An electronic device, comprising:

a processor; and

a memory configured to store instructions executable by the processor; wherein

the processor is configured to invoke the executable instructions stored in the memory to implement the method for detecting dealing sequence according to any one of claims 1 to 9.