

CLAIMS

What is claimed is:

1. An interaction behavior detection system, wherein the system comprises a depth photographing device and a processing device, the depth photographing device
5 is disposed above a rack, and a photographing range of the depth photographing device comprises an outer edge of each shelf in the rack and a specified aisle area;

the depth photographing device is configured to photograph a to-be-detected depth image comprising the rack and the specified aisle area at a specified angle, wherein the depth image comprises depth information of an actual object
10 corresponding to a pixel relative to a plane on which the depth photographing device is located; and

the processing device is configured to:

obtain the to-be-detected depth image from the depth photographing device;
extract a foreground image used to represent a moving object from the
15 to-be-detected depth image;

obtain spatial coordinate information of the moving object based on the foreground image;

compare the spatial coordinate information of the moving object with spatial coordinate information of a shelf in the rack;

20 determine an article touched by the moving object based on a comparison result and one or more articles on the shelf;

determine the spatial coordinate information of the shelf comprising:

obtaining a first background depth image set that is photographed by the depth photographing device;

25 determining a shelf edge line at a specified angle and comprises no foreground image in the first background depth image set, wherein determining the shelf edge line in the first background depth image set comprises:

preprocessing the first background depth image set, wherein the preprocessing comprises at least image averaging and image denoising;

30 performing edge detection on a preprocessed image;

performing straight line detection on an image obtained through edge detection at a predetermined angle; and

filtering out a straight line whose length is less than a predetermined length threshold to obtain the shelf edge line in the first background depth image set, wherein the predetermined angle is determined based on a relative position relationship between the depth photographing device and the rack;

5 converting pixel coordinates of the shelf edge line based on a camera calibration method of the depth photographing device, to obtain two-axis spatial coordinate information in actual spatial coordinate information of a shelf; and

 for edge lines of a same shelf, clustering depth information of pixels of the shelf edge lines to obtain third-axis spatial coordinate information in the actual
10 spatial coordinate information of the shelf.

2. The system according to claim 1, wherein the extracting, by the processing device, a foreground image used to represent a moving object from the to-be-detected depth image comprises:

 obtaining a background image, wherein the background image is obtained
15 by performing background modeling based on a second background depth image set, and the second background depth image set is a depth image set that is photographed by the depth photographing device at a specified angle and comprises no foreground image; and

 comparing the to-be-detected depth image with the background image, and
20 extracting the foreground image used to represent the moving object from the to-be-detected depth image.

3. The system according to claim 1, wherein the spatial coordinate information of the moving object comprises spatial coordinate information of a part closest to the rack in the moving object, and the obtaining, by the processing device, spatial
25 coordinate information of the moving object based on the foreground image comprises:

 converting pixel coordinates of a part closest to the rack in the foreground image based on a camera calibration method of the depth photographing device, to obtain two-axis spatial coordinate information of the part closest to the rack in the
30 moving object; and

 determining third-axis spatial coordinate information of the part closest to the rack in the moving object based on depth information of a pixel of the part closest to the rack in the foreground image.

4. The system according to any one of claims 1 to 3, wherein articles placed on a

same shelf in the rack are the same, and that the processing device is configured to compare the spatial coordinate information of the moving object with spatial coordinate information of a shelf in the rack, and determine an article touched by the moving object based on a comparison result and one or more articles on the shelf
5 comprises:

determining, based on the spatial coordinate information of the moving object and the spatial coordinate information of the shelf in the rack, whether the moving object extends into the rack by using the two-axis spatial coordinate information obtained by converting pixel coordinates in the spatial coordinate
10 information, and determining a shelf into which the moving object extends in the rack by using the third-axis spatial coordinate information obtained by converting depth information in the spatial coordinate information; and

determining an article corresponding to the determined shelf as the article touched by the moving object based on a predetermined correspondence between
15 shelves and articles.

5. An interaction behavior detection method, wherein the method comprises:

obtaining a to-be-detected depth image from a depth photographing device, wherein the depth photographing device is disposed above a rack, and a photographing range of the depth photographing device comprises an outer edge of
20 each shelf in the rack and a specified aisle area;

extracting a foreground image used to represent a moving object from the to-be-detected depth image;

obtaining spatial coordinate information of the moving object based on the foreground image;

25 comparing the spatial coordinate information of the moving object with spatial coordinate information of a shelf in the rack;

determining an article touched by the moving object based on a comparison result and one or more articles on the shelf;

determining the spatial coordinate information of the shelf comprising:

30 obtaining a first background depth image set that is photographed by the depth photographing device;

determining a shelf edge line at a specified angle and comprises no foreground image in the first background depth image set, wherein determining the shelf edge line in the first background depth image set comprises:

preprocessing the first background depth image set, wherein the preprocessing comprises at least image averaging and image denoising;

performing edge detection on a preprocessed image;

performing straight line detection on an image obtained through edge
5 detection at a predetermined angle; and

filtering out a straight line whose length is less than a predetermined length threshold to obtain the shelf edge line in the first background depth image set, wherein the predetermined angle is determined based on a relative position relationship between the depth photographing device and the rack;

10 converting pixel coordinates of the shelf edge line based on a camera calibration method of the depth photographing device, to obtain two-axis spatial coordinate information in actual spatial coordinate information of a shelf; and

for edge lines of a same shelf, clustering depth information of pixels of the shelf edge lines to obtain third-axis spatial coordinate information in the actual spatial
15 coordinate information of the shelf.

6. The method according to claim 5, wherein the extracting a foreground image used to represent a moving object from the to-be-detected depth image comprises:

obtaining a background image, wherein the background image is obtained by performing background modeling based on a second background depth image set,
20 and the second background depth image set is a depth image set that is photographed by the depth photographing device at a specified angle and comprises no foreground image; and

comparing the to-be-detected depth image with the background image, and extracting the foreground image used to represent the moving object from the
25 to-be-detected depth image.

7. The method according to claim 6, wherein the method further comprises:

comparing foreground positions of foreground images extracted from adjacent to-be-detected depth images, wherein the adjacent to-be-detected depth images are to-be-detected depth images photographed by the depth photographing device at
30 adjacent time points; and

determining a group of foreground images closest to each other in adjacent to-be-detected depth images as a same foreground image, and obtaining a moving path of the moving object corresponding to the foreground image.

8. The method according to claim 5, wherein the spatial coordinate information

of the moving object comprises spatial coordinate information of a part closest to the rack in the moving object, and the obtaining spatial coordinate information of the moving object based on the foreground image comprises:

converting pixel coordinates of a part closest to the rack in the foreground
5 image based on a camera calibration method of the depth photographing device, to obtain two-axis spatial coordinate information of the part closest to the rack in the moving object; and

determining third-axis spatial coordinate information of the part closest to the rack in the moving object based on depth information of a pixel of the part closest
10 to the rack in the foreground image.

9. The method according to any one of claims 5 to 8, wherein articles placed on a same shelf in the rack are the same, and the comparing the spatial coordinate information of the moving object with spatial coordinate information of a shelf in the rack, and determining an article touched by the moving object based on a comparison
15 result and one or more articles on the shelf comprises:

determining, based on the spatial coordinate information of the moving object and the spatial coordinate information of the shelf in the rack, whether the moving object extends into the rack by using the two-axis spatial coordinate information obtained by converting pixel coordinates in the spatial coordinate
20 information, and determining a shelf into which the moving object extends in the rack by using the third-axis spatial coordinate information obtained by converting depth information in the spatial coordinate information; and

determining an article corresponding to the determined shelf as the article touched by the moving object based on a predetermined correspondence between
25 shelves and articles.

10. An interaction behavior detection apparatus, wherein the apparatus comprises:

an image acquisition module, configured to obtain a to-be-detected depth image from a depth photographing device, wherein the depth photographing device is
30 disposed above a rack, and a photographing range of the depth photographing device comprises an outer edge of each shelf in the rack and a specified aisle area;

a foreground extraction module, configured to extract a foreground image used to represent a moving object from the to-be-detected depth image;

a coordinate determining module, configured to obtain spatial coordinate

information of the moving object based on the foreground image;

an interaction article determining module, configured to compare the spatial coordinate information of the moving object with spatial coordinate information of a shelf in the rack, and determine an article touched by the moving object based on a comparison result and one or more articles on the shelf; and

an information pre-determining module configured to determine the spatial coordinate information of the shelf comprising:

obtaining a first background depth image set that is photographed by the depth photographing device;

determining a shelf edge line at a specified angle and comprises no foreground image in the first background depth image set, wherein determining the shelf edge line in the first background depth image set comprises:

preprocessing the first background depth image set, wherein the preprocessing comprises at least image averaging and image denoising;

performing edge detection on a preprocessed image;

performing straight line detection on an image obtained through edge detection at a predetermined angle; and

filtering out a straight line whose length is less than a predetermined length threshold to obtain the shelf edge line in the first background depth image set, wherein the predetermined angle is determined based on a relative position relationship between the depth photographing device and the rack;

converting pixel coordinates of the shelf edge line based on a camera calibration method of the depth photographing device, to obtain two-axis spatial coordinate information in actual spatial coordinate information of a shelf; and

for edge lines of a same shelf, clustering depth information of pixels of the shelf edge lines to obtain third-axis spatial coordinate information in the actual spatial coordinate information of the shelf.

11. A computer device, comprising:

a processor; and

a memory, configured to store a processor-executable instruction, wherein the processor is configured to:

obtain a to-be-detected depth image from a depth photographing device, wherein the depth photographing device is disposed above a rack, and a photographing range of the depth photographing device comprises an outer edge of each shelf in the rack

and a specified aisle area;

extract a foreground image used to represent a moving object from the to-be-detected depth image;

5 obtain spatial coordinate information of the moving object based on the foreground image;

compare the spatial coordinate information of the moving object with spatial coordinate information of a shelf in the rack;

determine an article touched by the moving object based on a comparison result and one or more articles on the shelf;

10 determine the spatial coordinate information of the shelf comprising:

obtaining a first background depth image set that is photographed by the depth photographing device;

determining a shelf edge line at a specified angle and comprises no foreground image in the first background depth image set, wherein determining the shelf edge line in the first background depth image set comprises:

preprocessing the first background depth image set, wherein the preprocessing comprises at least image averaging and image denoising;

performing edge detection on a preprocessed image;

performing straight line detection on an image obtained through edge detection at a predetermined angle; and

20 filtering out a straight line whose length is less than a predetermined length threshold to obtain the shelf edge line in the first background depth image set, wherein the predetermined angle is determined based on a relative position relationship between the depth photographing device and the rack;

25 converting pixel coordinates of the shelf edge line based on a camera calibration method of the depth photographing device, to obtain two-axis spatial coordinate information in actual spatial coordinate information of a shelf; and

for edge lines of a same shelf, clustering depth information of pixels of the shelf edge lines to obtain third-axis spatial coordinate information in the actual spatial coordinate information of the shelf.