CLAIMS

1. A method for retrieving an inventory item based on a handling robot, wherein:

the handling robot comprises:

a movable chassis, moving along a travelling direction;

a storage frame, installed on the movable chassis, and provided with a plurality of storage units distributed in a vertical direction, each storage unit being configured to place an inventory item;

a material handling device for transporting the inventory item between a warehouse shelf and any one of the storage units, wherein the material handling device has a preset horizontal reference line, and comprises a telescopic arm and a pusher assembly, the pusher assembly comprises a manipulator that is installed on the telescopic arm, and the telescopic arm, the pusher assembly and the manipulator move along the reference line;

a lifting assembly for driving the material handling device to move in the vertical direction; and

a detection device for detecting position information of the material handling device relative to the warehouse shelf, the storage units and the inventory item by determining a positional relationship between the warehouse shelf, the storage units and the inventory item and the reference line;

the material handling device further comprises:

a temporary storage unit provided with the telescopic arm and the detection device;

a fork, comprising the telescopic arm, the temporary storage unit, the detection device, and the manipulator;

a support bracket, installed on the lifting assembly; and

a rotation assembly, installed between the fork and the support bracket;

the method for retrieving an inventory item comprises:

when a preset position of an inventory item on the warehouse shelf is on the reference line, driving, by the telescopic arm, the manipulator to extend to the preset position along the reference line;

loading, by the manipulator that is remained on a horizontal plane where the reference line is located, the inventory item;

when one storage unit is on the reference line, driving, by the telescopic arm, the manipulator loaded with the inventory item to move to the storage frame along the reference line; and

unloading, by the manipulator that is remained on the horizontal plane where the reference line is located, the inventory item to the storage frame;

the method for retrieving an inventory item further comprises:

causing the movable chassis to move in the travelling direction according to the position information, driving, by the lifting assembly, the material handling device to move in the vertical direction according to the position information, so that the preset position of the inventory item is located on the reference line; and

after the manipulator is loaded with the inventory item, driving, by the lifting assembly, the material handling device to move along the vertical direction according to the position information, so that one storage unit is located on the reference line;

the position information of the material handling device relative to the inventory item comprises a first position offset between the inventory item and the reference line in the travelling direction, and a second position offset between the inventory item and the reference line in the vertical direction, and a distance between the inventory item and the manipulator along the reference line;

the method for retrieving an inventory item further comprise:

causing the movable chassis to move along the travelling direction according to the first position offset, so that the first position offset is smaller than a first error value; and

driving, by the lifting assembly, the material handling device to move in the vertical direction according to the second position offset, so that the second position offset is smaller than a second error value; and

adjusting an extension amount of the telescopic arm along the reference line according to the distance, so that the extension amount is larger than the distance;

the position information of the material handling device relative to the inventory item further comprises: a deflection amount between the inventory item and the reference line in a horizontal direction;

the method for retrieving an inventory item further comprise:

driving, by the rotation assembly, the fork to rotate around the vertical direction according to the deflection amount, so that the deflection amount is smaller than a third error value.

2. The method for retrieving an inventory item according to claim 1, further comprising:

before the lifting assembly drives the material handling device to move in the vertical direction so that the material handling device horizontally faces to the preset position, causing the movable chassis to move to a preset range in front of the warehouse shelf.

3. The method for retrieving an inventory item according to claim 1, wherein:

the detection device comprises a camera device, a laser guiding device or an infrared sensor for obtaining image information, wherein the camera device is configured to collect a two-dimensional code label attached on a surface of the inventory item facing the handling robot, so as to obtain the position information of the material handling device relative to the inventory item.

4. The method for retrieving an inventory item according to claim 1, wherein:

the method for retrieving an inventory item further comprises:

before the telescopic arm drives the manipulator loaded with the inventory item to move to the storage frame along the reference line, driving, by the telescopic arm, the manipulator loaded with the inventory item to retract to the temporary storage unit along the reference line;

unloading, by the manipulator that is remained on the horizontal plane where the reference line is located, the inventory item to the temporary storage unit; and

pushing, by the pusher assembly, the inventory item located on the temporary storage unit to the corresponding storage units in the storage frame along the reference line.

5. The method for retrieving an inventory item according to claim 4, wherein:

the rotation assembly comprises a first rotation member and a second rotation member;

the first rotation member is installed to the support bracket;

the second rotation member is installed to the temporary storage unit, and rotates around a vertically set rotation axis relative to the first rotation member, so that the fork rotates around the rotation axis relative to the support bracket;

6. The method for retrieving an inventory item according to claim 4, wherein:

the handling robot further comprises:

a deflection detection device, connected between the fork and the support bracket;

the driving, by the rotation assembly, the fork to rotate around the vertical direction, comprises:

when the deflection detection device detects that the fork has not yet rotated to the preset angle, driving, by the rotation assembly, the fork to continue to rotate;

when the deflection detection device detects that the fork has rotated over the preset angle, driving, by the rotation assembly, the fork to rotate in a reverse direction; and

when the deflection detection device detects that the fork rotates to the preset angle, causing the rotation assembly to stop rotating.

7. The method for retrieving an inventory item according to claim 6, wherein:

the deflection detection device comprises:

a first sensor, provided with a first detection range;

a second sensor, provided with a second detection range;

when the first sensor detects the fork in the first detection range, and the second sensor does not detect the fork in the second detection range, the deflection detection device detects that the fork has not yet rotated to the preset angle;

when the first sensor does not detect the fork in the first detection range, and the second sensor detects the fork in the second detection range, the deflection detection device detects that the fork has rotated over the preset angle; and

when the first sensor detects the fork in the first detection range, and the second sensor detects the fork in the second detection range, the deflection detection device detects that the fork rotates to the preset angle.

8. The method for retrieving an inventory item according to claim 1, wherein:

the inventory item comprises a first inventory item and a second inventory item;

the preset position comprises a first preset position and a second preset position, the first inventory item is located at the first preset position, and the second inventory item is located at the second preset position;

the storage frame comprises a first storage unit and a second storage unit;

when there is the second inventory item back behind the first inventory item, the method for retrieving an inventory item further comprises:

driving, by the telescopic arm, the manipulator to extend to the first preset position of the warehouse shelf along the reference line;

loading, by the manipulator that is remained on the horizontal plane where the reference line is located, the first inventory item located at the first preset position;

driving, by the telescopic arm, the manipulator loaded with the first inventory item to move to the first storage unit along the reference line;

unloading, by the manipulator that is remained on the horizontal plane where the reference line is located, the first inventory item to the first storage unit;

driving, by the telescopic arm, the manipulator to move to the second preset position of the warehouse shelf along the reference line;

loading, by the manipulator that is remained on the horizontal plane where the reference line is located, the second inventory item located at the second preset position;

driving, by the telescopic arm, the manipulator loaded with the second inventory item to move to the second storage unit along the reference line; and

unloading, by the manipulator that is remained on the horizontal plane where the reference line is located, the second inventory item to the second storage unit.

9. The method for retrieving an inventory item according to claim 8, further comprising:

driving, by the telescopic arm, the manipulator to move to the first storage unit along the reference line;

driving, by the telescopic arm, the manipulator to be remained at the reference line and to load the first inventory item located at the first storage unit;

driving, by the telescopic arm, the manipulator loaded with the first inventory item to move to the first preset position of the warehouse shelf along the reference line; and

unloading, by the manipulator that is remained on the horizontal plane where the reference line is located, the first inventory item to the first preset position of the warehouse shelf;

or

the method for retrieving an inventory item further comprises:

driving, by the telescopic arm, the manipulator to move to the first storage unit along the reference line;

driving, by the telescopic arm, the manipulator to be remained on the horizontal plane where the reference line is located, to load the first inventory item located at the first storage unit;

driving, by the telescopic arm, the manipulator loaded with the first inventory item to move to the second preset position of the warehouse shelf along the reference line;

unloading, by the manipulator that is remained on the horizontal plane where the reference line is located, the first inventory item to the second preset position of the warehouse shelf; and

uploading current position information of the first inventory item.

10. A handling robot, comprising:

a movable chassis, moving along a travelling direction;

a storage frame, installed on the movable chassis, and provided with a plurality of storage units distributed in a vertical direction, each storage unit being configured to place an inventory item;

a material handling device for transporting the inventory item between a warehouse shelf and any one of the storage units, the material handling device having a preset horizontal reference line, and comprising a pusher assembly that is movable along the reference line;

a lifting assembly for driving the material handling device to move in the vertical direction, so that any one of the storage units is located on the reference line; and

a detection device for detecting position information of the material handling device relative to the warehouse shelf, the storage units and the inventory item by determining a positional relationship between the warehouse shelf, the storage units and the inventory item and the reference line;

the material handling device comprises a support bracket, a fork, and a rotation assembly;

when one of the storage units is located on the reference line, the pusher assembly pushes the inventory item to a corresponding storage unit along the reference line, or the pusher assembly pulls the inventory item located at the corresponding storage unit away therefrom;

the movable chassis is configured to move in the travelling direction according to the position information, and the lifting assembly is configured to drive the material handling device to move in the vertical direction according to the position information;

the position information of the material handling device relative to the inventory items comprises a first position offset between the inventory item and the reference line in the travelling direction of the movable chassis, and a second position offset between the inventory item and the reference line in the vertical direction;

the movable chassis is configured to move along the travelling direction according to the first position offset so that the first position offset is less than a first error value; and

the lifting assembly is configured to drive the material handling device to move in the vertical direction according to the second position offset so that the second position offset is smaller than a second error value;

the position information of the material handling device relative to the inventory item further comprises: a deflection amount between the inventory item and the reference line in a horizontal direction;

the rotation assembly is configured to drive the fork to rotate around the vertical direction according to the deflection amount, so that the deflection amount is smaller than a third error value.

11. The handling robot according to claim 10, wherein the material handling device further comprises a temporary storage unit;

the temporary storage unit is configured to temporarily store an inventory item that is to be transported between the warehouse shelf and any one of the storage units, and the temporary storage unit has the reference line;

when one of the storage units is located on the reference line, the pusher assembly pushes an inventory item located on the temporary storage unit to a

corresponding storage unit along the reference line, or the pusher assembly pulls an inventory item on a corresponding storage unit to the temporary storage unit.

12. The handling robot according to claim 11, wherein the material handling device further comprises a telescopic arm;

the telescopic arm comprises an outer arm section, a middle arm section and an inner arm section, the outer arm section is fixedly installed to the temporary storage unit, the middle arm section is installed on the outer arm section, and the inner arm section is installed to the middle arm section, the middle arm section moves relative to the outer arm section along the reference line, the inner arm section moves relative to the middle arm section along the reference line;

the pusher assembly is installed to the inner arm section;

the inner arm section moves relative to the outer arm section along the reference line, so that the pusher assembly moves relative to the storage frame along the reference line.

13. The handling robot according to claim 12, wherein the pusher assembly comprises a manipulator and a fixed push rod;

the manipulator is installed at an end of the inner arm section, so that the manipulator moves relative to the storage frame along the reference line, and the manipulator unfolds or fold relative to the inner arm section;

when the manipulator folds relative to the inner arm section, an end of the inner arm section installed with the manipulator moves to another side from one side of the inventory item on the storage unit or the warehouse shelf that is located on the reference line, so that when the manipulator folds is unfolded relative to the inner arm section, the manipulator pulls a corresponding inventory item to the temporary storage unit;

the fixed push rod is installed on an end of the inner arm section away from the manipulator, so that the fixed push rod moves relative to the storage frame along the reference line;

the fixed push rod is configured to push the inventory item placed on the temporary storage unit to the storage unit located on the reference line, or to push the inventory item placed in the temporary storage unit to an empty position of the warehouse shelf,

14. The handling robot according to claim 13, wherein the pusher assembly further comprises a push rod driving device;

the push rod driving device is connected to the manipulator, and is configured to drive the manipulator to rotate relative to the inner arm section, so that the manipulator folds or unfolds relative to the inner arm section.

15. The handling robot according to claim 12, wherein the telescopic arm further comprises an inner arm section driving assembly;

the inner arm section driving assembly comprises a movable pulley and a sliding chain, the movable pulley is a flat belt pulley and the sliding chain is an open-loop flat belt;

the movable pulley is installed on the middle arm section;

a middle part of the sliding chain is arranged to be bent and sleeved over the movable pulley, so that both ends of the sliding chain are oppositely arranged, one end being fixedly connected to the outer arm section, and the other end being fixedly connected to the inner arm section;

when the middle arm section moves at a first speed relative to the outer arm section along the reference line, the inner arm section moves at a second speed relative to the outer arm section along the reference line, and the second speed is twice the first speed.

16. The handling robot according to claim 11, wherein the support bracket is installed on the lifting assembly, and the lifting assembly is configured to drive the support bracket to move in the vertical direction;

the fork comprises the temporary storage unit, the telescopic arm, and the pusher

assembly;

the rotation assembly comprises a first rotation member and a second rotation member;

the first rotation member is installed to the support bracket;

the second rotation member is installed to the temporary storage unit, and rotates around a vertically set rotation axis relative to the first rotation member, so that the fork rotates around the rotation axis relative to the support bracket.