

LIFTING DEVICE, CONTROL DEVICE OF LIFTING DEVICE AND METHOD THEREOF, CONTROL DEVICE OF ELECTRONIC GUIDE PLATE AND METHOD THEREOF

TECHNICAL FIELD

[0001] The present application relates to the technical field of transportation, in particular, to a lifting device and its control device and method, and a control device of an electronic guide plate and its method.

BACKGROUND

[0002] In order to realize the automation and unmanned operation of the quay yard, the deviation detection and real-time recognition of the spreader orientation in the yard are particularly important. In the traditional method, mechanical guide plate is used in the process of box alignment. When the mechanical guide plate is used to pick and drop the box in a non-empty spreader, it is difficult to realize automatic box alignment and requires manual operation and alignment. In addition, the mechanical guide plate also cannot perform deviation detection function. Therefore, there are problems when using mechanical guide plate such as, large impact force, high security risk, and incapability of deviation recognition and accurate adjustment.

[0003] In order to solve the defects of the mechanical guide plate, the deviation detection is mainly carried out by LPS (angle detection of the spreader orientation) and TPS (deviation detection of the spreader and the target container). The laser structured light source method and the scanner method are usually used in the above detection process. However, when the automated yard is automatically picking and placing containers, these methods cannot quickly and timely detect the deviation between the spreader and the container, and cannot perform mutual inspection, and thus resulting in poor reliability.

[0004] In summary, with the abovementioned methods, the deviation cannot be accurately detected the redundancy inspection cannot be performed, and the effectiveness and reliability are poorly resulted.

SUMMARY

[0005] In view of this, the purpose of this application is to provide a lifting device, its control device and method, and an electronic guide plate control device and method, which can accurately detect deviation and adjust the angle deviation, improve the adjustment efficiency of the lifting device, and shorten the time required for the adjustment process.

[0006] In a first aspect, the present application provides a control device of an electronic guide plate, including: a first collection device, configured for collecting a first point cloud data; a second collection device, configured for collecting a second point cloud data; and a controller, connected to the first collection device and the second collection device respectively. The controller is used to control lifting or dropping of the spreader according to the first point cloud data and/or the second point cloud data; and the first collection device and the second collection device are arranged into the electronic guide plate.

[0007] In a second aspect, the present application provides a control method of an electronic guide plate, including: collecting a first point cloud data; collecting a second point cloud data; and controlling a spreader to lift or drop according to the first point cloud data and/or the second point cloud data.

[0008] In a third aspect, the present application provides a lifting device includes: a spreader, including a spreader body and a plurality of lifting-part mounting parts, the plurality of lifting-part mounting parts being evenly distributed on a same side of the spreader body, and being configured to mount the lifting parts; a plurality of adjustment mechanisms connecting to one of the lifting-part mounting parts respectively, a plurality of electronic guide plates connecting to one of the lifting-part mounting parts respectively for detecting the orientation information of the spreader; where a first collection device and a second collection device are disposed in the electronic guide plate for collecting a first point cloud data and a second point cloud data respectively;

and a controller connecting to the plurality of electronic guide plates and configured to control the adjustment mechanism to adjust the orientation of the spreader based on the orientation information obtained by the electronic guide plates.

[0009] In a fourth aspect, the present application provides a control method of a lifting device, including: obtaining an orientation deviation information between the lifting device and a container; determining an angle deviation between the lifting device and the container based on the orientation deviation information between the lifting device and the container; and controlling an adjustment mechanism to adjust an orientation of the lifting device according to the angle deviation between the lifting device and the container such that the angle deviation between the lifting device and the container satisfying a preset deviation condition.

[0010] In a fifth aspect, the present application provides a lifting control device, including: an acquisition module, configured for acquiring an orientation deviation information between the lifting device and the container; a determining module, configured to determine an angle deviation between the lifting device and the container based on the orientation deviation information between the lifting device and the container; and a controlling module, configured to control an adjustment mechanism to adjust the orientation of the lifting device according to the angle deviation between the lifting device and the container, such that the angle deviation between the lifting device and the container satisfying a preset deviation condition.

[0011] In a sixth aspect, the present application provides a computer device, including: a processor; a memory; and a bus. The memory stores machine-readable instructions executed by the processor, and when the computer device operates, the processor and the memory are communicated with each other by the bus, and the machine-readable instructions are used to perform steps of the method of any one of the abovementioned methods.

[0012] In a seventh aspect, the present application provides a computer-readable storage medium, where the computer-readable storage medium stores computer programs, and the computer programs are used to execute any one of the abovementioned methods.

[0013] BRIEF DESCRIPTION OF DRAWINGS

[0014] FIG. 1 is a schematic structural diagram of a control device of an electronic guide plate according to an embodiment of the present application.

[0015] FIG. 2 is a schematic diagram of a control device of an electronic guide plate provided by another embodiment of the present application.

[0016] FIG. 3 is a schematic diagram of a control device of an electronic guide plate provided by another embodiment of the present application.

[0017] FIG. 4 is a schematic diagram of the internal structure of an electronic guide plate according to an embodiment of the present application.

[0018] FIG. 5 is a schematic diagram of the internal structure of an electronic guide plate according to another embodiment of the present application.

[0019] FIG. 6 is a schematic diagram of an electronic guide plate mounted on a spreader according to an embodiment of the present application.

[0020] FIG. 7 is a flowchart of a control method of an electronic guide plate provided by an embodiment of the present application.

[0021] FIG. 8 is a flowchart of a control method for an electronic guide plate provided by another embodiment of the present application.

[0022] FIG. 9 is a flowchart of a control method for an electronic guide plate provided by another embodiment of the present application.

[0023] FIG. 10 is a flowchart of a control method of an electronic guide plate provided by another embodiment of the present application.

[0024] FIG. 11 is a flowchart of a control method for an electronic guide plate provided by another embodiment of the present application.

[0025] FIG. 12 is a schematic diagram of a system structure of a lifting device according to another embodiment of the present application.

[0026] FIG. 13 is a schematic structural diagram of an electronic guide plate according to an embodiment of the present application.

[0027] FIG. 14 is a flowchart of a method for controlling a lifting device according to an embodiment of the present application.

[0028] FIG. 15 is a schematic diagram of a control device of a lifting device according to an embodiment of the present application.

[0029] FIG. 16 is a schematic structural diagram of a computer device according to an embodiment of the present application.

[0030] Reference numbers are as following:

[0031] 1-first collection device; 2-second collection device; 3-controller; 11-point laser distance meter; 12-line laser distance meter; 13-camera; 4-trolley; 5-spreader; 6-electronic guide plate; 7- cart; 100-lifting device; 103-lifting part; 104-adjustment mechanism; 1021-laser; 1022-radar; 1024-angle sensor.

DETAILED DESCRIPTIONS

[0032] In order to make the objectives, technical means and advantages of the present application more clear, the present application will be further clarified in detail below in conjunction with the reference drawings.

[0033] FIG. 1 is a schematic structural diagram of a control device of an electronic guide plate according to an embodiment of the application.

[0034] Referring to FIG.1, the device includes: a first collection device 1, a second collection device 2 and a controller 3 (eg. Programmable Logic Controller, PLC for short), the first collection device 1 and the second collection device 2 are disposed in the electronic guide plate, the first collection device 1 and the second collection device 2 are connected to the controller 3 respectively, the first collection device 1 is used to collect a first point cloud data, the second collection device 2 is used to collect a second point cloud data, and the controller 3 controls the lifting or dropping of the spreader according to the first point cloud data collected by the first collection device1 and/or the second point cloud data collected by the second collection device 2.

[0035] An embodiment of the present application provides a control device for an electronic guide plate, the control device includes a first collection device, a second collection device and a controller. The first collection device and the second collection

device are disposed in the electronic guide plate; the first collection device and the second collection device are connected to the controller respectively; the first collection device is used to collect a first point cloud data; the second collection device is used to collect a second point cloud data; and the controller is used to obtain a first orientation data according to the first point cloud data, and obtain a second orientation data according to the second point cloud data. The first orientation data and/or the second orientation data are inspected, and the spreader is controlled to lift or drop according to the inspection results, so that the deviation can be accurately detected, and the inspection can be carried out with high reliability.

[0036] In one embodiment, the electronic guide plate is a metal plate with a thickness of no less than 5 mm, and is equipped with anti-loosening measures. The structural configuration of the electronic guide plate adopts a closed or semi-closed box structure, with width being about 10 mm, length being about 30 mm, and height being about 20mm, and one side of the box body is arranged as a scanning port. The electronic guide plate can adjust the distance of about $\pm 5\text{cm}$ or adjust the angle of about $\pm 5^\circ$ based upon different working conditions.

[0037] The first collection device 1 and the second collection device 2 are connected to the controller 3 respectively.

[0038] The first collection device 1 is used to collect a first point cloud data.

[0039] The second collection device 2 is used to collect a second point cloud data.

[0040] The controller 3 is used to obtain a first orientation data according to the first point cloud data, obtain the second orientation data according to the second point cloud data, verify the first orientation data and/or the second orientation data to obtain the inspection result, and control the spreader to lift or drop according to the inspection result.

[0041] In one embodiment, the first collection device 1 includes a point laser distance meter or a camera, and the second collection device 2 includes a line laser distance meter.

[0042] Specifically, referring to FIG. 2, the first collection device 1 includes a point laser distance meter 11, the second collection device 2 includes a line laser distance

meter 12, and the point laser distance meter 11 and the line laser distance meter 12 are connected to the controller 3 respectively.

[0043] Furthermore, the first collection device 1 includes a point laser distance meter 11 or a camera 13 for collecting a first point cloud data; a line laser distance meter 12 for collecting a second point cloud data.

[0044] Furthermore, the controller 3 is used to filter the first point cloud data and the second point cloud data to obtain point cloud data that satisfies the preset lift-and-drop condition; the point cloud data that satisfies the preset lift-and-drop condition is the actual distance measured by the point laser or the actual distance measured by the line laser within the range of the lift-and-drop distance.

[0045] Specifically, the point laser distance meter 11 collects the first point cloud data, the line laser distance meter 12 collects the second point cloud data, the point laser distance meter 11 sends the first point cloud data to the controller 3, and the line laser distance meter 12 sends the second point cloud data to the controller 3. The controller 3 filters the first point cloud data and the second point cloud data. The controller 3 filters the point cloud data that does not meet the preset lift-and-drop condition, and obtains the point cloud data that satisfies the preset lift-and-drop condition. The point cloud data that satisfies the preset lift-and-drop condition is the actual distance measured by the point laser or the actual distance measured by the line laser, where the actual distance measured by the point laser includes the distance from the point laser to the container, the distance from the point laser to the ground, the distance from the point laser to the ground and the edge of the container. The actual distance measured by the line laser includes the distance from the line laser to the container, the distance from the line laser to the ground, and the distance from the line laser to the ground and the edge of the container.

[0046] The distance deviation can be obtained by comparing the actual distance with the first preset distance; when the distance deviation is less than or equal to the second preset distance, the point laser distance meter 11 is used for inspection and verification, and the distance deviation in the vertical downward direction is collected; when the distance is greater than the second preset distance, the line laser distance meter 12 is used for inspection and verification, and the distance deviation in the horizontal direction is collected.

[0047] Specifically, the second preset distance includes but not limited to 3.5 cm. When the distance deviation is less than or equal to the second preset distance, the point laser distance meter 11 is used for inspection and verification, and the distance deviation in the vertical downward direction is collected; when the distance deviation is greater than the second preset distance, the line laser distance meter 12 is used for inspection and verification, and the distance deviation in the horizontal direction is collected. In this embodiment, by using the combination of the point laser distance meter 11 and the line laser distance meter 12, the verification will be performed when the distance deviation is in different ranges, thus the reliability of the electronic guide plate can be improved, and the deviation can be accurately detected.

[0048] Furthermore, the control device of the electronic guide plate can also include an angle sensor; the angle sensor is used to collect the rotation angle, the angle sensor is connected to the controller; the controller obtains a first orientation data according to the distance deviation in the vertical downward direction collected by the point laser distance meter 11, or obtains a second orientation data according to the distance deviation in the horizontal direction collected by the line laser distance meter 12 and the rotation angle collected by the angle sensor.

[0049] Furthermore, the controller 3 is used to select the first orientation data that satisfies the above preset lift-and-drop condition from the first orientation data, or select the second orientation data that satisfies the above preset lift-and-drop condition from the second orientation data. According to the first orientation data that satisfies the preset lift-and-drop condition selected from the first orientation data or the second orientation data that satisfies the preset lift-and-drop condition selected from the second orientation data, the controller 3 is used to control the lifting or dropping of the spreader.

[0050] Furthermore, the controller 3 is used to judge whether the first orientation data and the second orientation data are consistent, and if they are consistent, the controller 3 will control the lifting or dropping of the spreader.

[0051] Specifically, referring to FIG. 3, the camera 13 collects the first point cloud data, the line laser distance meter 12 collects the second point cloud data, the controller 3 obtains the first orientation data according to the first point cloud data, obtains the second orientation data according to the second point cloud data, judges that whether the first orientation data from the first point cloud data obtained by camera 13 is

consistent with the second orientation data from the second point cloud data obtained by the line laser distance meter 12, and thus carries out mutual inspection, hence improving the reliability. When the first orientation data is consistent with the second orientation data, the spreader is controlled to lift or drop.

[0052] Furthermore, referring to FIG. 4, the angle deviation between the working plane of the line laser distance meter and the working plane of the point laser distance meter is within the range of the first threshold, and the angle deviation between the scanning plane of the line laser distance meter and the wire harness of the point laser distance meter is within the first threshold range.

[0053] When the line laser distance meter and the point laser distance meter are combined, both the point laser distance meter and the line laser distance meter are disposed in the electronic guide plate, and the distance between the point laser distance meter and the line laser distance meter may be about 30 mm. The first threshold range may be about $\pm 10^\circ$.

[0054] Furthermore, referring to FIG. 5, the angle deviation between the working plane of the line laser distance meter and the projection plane of the camera is within the second threshold range.

[0055] When the line laser distance meter and the camera are combined, both the line laser distance meter and the camera are disposed in the electronic guide plate, the distance between the line laser distance meter and the camera is about 30 mm, and the field of view collected by the camera needs to cover the box corners of the target box. The second threshold range may be around $\pm 5^\circ$.

[0056] Referring to FIG. 6, the electronic guide plate 6 is disposed on the spreader 5, the spreader 5 is connected to the trolley 4 through a connecting line, and the spreader 5 is driven to move in left or right direction by sliding of the trolley 4. The trolley 4 is disposed on the cart 7, and the cart 7 rotates in multiple directions via the universal wheels.

[0057] FIG. 7 is a flowchart of a control method of an electronic guide plate provided by an embodiment of the present application.

[0058] With reference to FIG. 7, the method applied to the abovementioned electronic guide plate control device includes the following steps S110-S130.

[0059] Step S110: collecting a first point cloud data.

[0060] Step S120: collecting a second point cloud data.

[0061] Step S130: controlling a spreader to lift or drop according to the first point cloud data and/or the second point cloud data.

[0062] An embodiment of the present application provides a control method of an electronic guide plate, including: collecting a first point cloud data, collecting a second point cloud data, and controlling the spreader to lift or drop according to the first point cloud data and/or the second point cloud data with high reliability.

[0063] FIG. 8 is a flowchart of a control method of an electronic guide plate provided by another embodiment of the present application.

[0064] Referring to FIG.8, the above step S130 may include the following sub-steps S131-S134.

[0065] Step S131: obtaining a first orientation data according to the first point cloud data.

[0066] Step S132: obtaining a second orientation data according to the second point cloud data.

[0067] Step S133: inspecting the first orientation data and/or the second orientation data to obtain an inspection result.

[0068] Step S134: controlling the spreader to lift or drop fall according to the verification result.

[0069] An embodiment of the present application provides a control method of an electronic guide plate including: obtaining a first orientation data according to the first point cloud data, obtaining a second orientation data according to the second point cloud data, inspecting the first orientation data and/or second orientation data, and controlling the spreader to lift or drop according to the inspection result. Deviation is accurately detected and inspected with high reliability.

[0070] In an embodiment, a specific implementation of the above step S134 may include: when the first orientation data and the second orientation data are consistent, controlling the spreader to lift or drop.

[0071] FIG. 9 is a flowchart of a control method of an electronic guide plate provided by another embodiment of the present application.

[0072] Referring to FIG. 9, the above-mentioned embodiment may further include:

[0073] Step S140: collecting a rotation angle.

[0074] Correspondingly, step S132 is adjusted to obtain the second orientation data according to the second point cloud data and the rotation angle.

[0075] FIG. 10 is a flowchart of a control method of an electronic guide plate provided by another embodiment of the present application.

[0076] Referring to FIG.10, following the step S131 and the step S132, the above-mentioned embodiment may further include:

[0077] Step S150: selecting the first orientation data that satisfies the preset lift-and-drop condition from the first orientation data, or selecting the second orientation data that satisfies the preset lift-and-drop condition from the second orientation data. The preset lift-and-drop condition is corresponding to that the actual distance is within the lift-and-drop distance range.

[0078] Correspondingly, the above step S133 is adjusted to the following:

[0079] inspecting the first orientation data that satisfies the preset lift-and-drop condition and/or the second orientation data that satisfies the preset lift-and-drop condition to obtain the inspection result.

[0080] FIG. 11 is a flowchart of a control method of an electronic guide plate provided by another embodiment of the present application.

[0081] Referring to FIG.11, following the step S110 and the step S120, the above-mentioned embodiment may further include steps S160-S180.

[0082] Step S160: filtering the first point cloud data and/or the second point cloud data to obtain the first point cloud data that satisfies the preset lift-and-drop condition and/or the second point cloud data that satisfies the preset lift-and-drop condition. The preset lift-and-drop condition is that the corresponding actual distance is within the lift-and-drop distance range;

[0083] Step S170: comparing the actual distance with the first preset distance to obtain the distance deviation;

[0084] Step S180: when the distance deviation is less than or equal to the second preset distance, the first collection device performs detection and verification, and the distance deviation in the vertical downward direction is collected.

[0085] Correspondingly, step S130 may include:

[0086] Step S135: controlling the spreader to lift or drop according to the distance deviation in the vertical downward direction.

[0087] In an embodiment, as shown in FIG. 11, the above-mentioned embodiment may further include:

[0088] Step S190: when the distance deviation is greater than the second preset distance, the second collection device performs detection and verification, and the distance deviation in the horizontal direction is collected.

[0089] Correspondingly, step S130 may include:

[0090] Step S136: controlling the spreader to lift or drop according to the distance deviation in the horizontal direction.

[0091] As shown in FIG. 12, an embodiment of the present application provides a lifting device 100 including a spreader 5, an electronic guide plate 6, a lifting-part 103, an adjustment mechanism 104 and a controller 3.

[0092] The spreader 5 includes a plurality of lifting-part 103 mounting parts evenly distributed on the same side of the spreader body, the lifting-part mounting parts are used to mount the lifting-part 103, and each lifting-part mounting part is connected to one adjustment mechanism 104.

[0093] There are at least two electronic guide plates 6, and the different electronic guide plates 6 are connected to different lifting-part mounting parts to detect the orientation information between the spreader 5 and the container; the orientation information includes the orientation deviation information between the spreader 5 and the container. The lifting device in the embodiment of the present application includes a first collection device for collecting a first point cloud data and a second collection device for collecting a second point cloud data, and the first collection device and the

second collection device are disposed in the electronic guide plate 6, and the orientation information may also include the first point cloud data or the second point cloud data in the abovementioned embodiment.

[0094] The controller 3 is connected to the electronic guide plate 6, and is used for controlling the adjustment mechanism 104 to adjust the orientation of the spreader 5 based on the orientation deviation information obtained by the electronic guide plate 6.

[0095] Exemplarily, the electronic guide plate 6 is mounted on one side of the outer edge of the spreader 5. The electronic guide plate 6 can be mounted on the long side of the outer edge of the spreader 5, or can be mounted on the short side of the outer edge of the spreader 5. In order for the electronic guide plate 6 to collect more information, the electronic guide plate 6 is usually mounted on the long side of the outer edge of the spreader 5.

[0096] FIG. 13 is a structural schematic diagram of an electronic guide plate according to an embodiment of the present application.

[0097] The electronic guide plate 6 may include at least one of the laser 1021, the radar 1022, the camera 13 and the angle sensor 1024. The laser 1021 may include the above-mentioned point laser distance meter 11 or line laser distance meter 12.

[0098] In one embodiment, as shown in FIG. 13, the electronic guide plate 6 may include a laser 1021, and the laser 1021 is mounted at a predetermined distance from the outer edge of the spreader 5.

[0099] In one embodiment, as shown in FIG. 13, the electronic guide plate 6 may include a radar 1022, and the angle between the scanning plane of the radar 1022 and the plane formed by the lifting-part 103 satisfies a preset angle.

[0100] In one embodiment, as shown in FIG. 13, the electronic guide plate 6 may include a camera 13, the optical axis of the camera 13 and the plane formed by the lifting-part 103 form a preset angle, and the distance between the camera 13 and the outer edge of the spreader 5 is within a preset distance.

[0101] Exemplarily, the laser 1021 is a single-point laser, and the single-point laser can be mounted at a position of about 3 cm along the outer edge of the spreader.

[0102] Exemplarily, the radar 1022 is a single-line radar, and the scanning plane of the single-line radar and the plane formed by the lifting-part 103 satisfies any one of the following relationships.

[0103] The scanning plane of the radar 1022 is perpendicular to the plane formed by the lifting-part 103, and the predetermined angle is satisfied between the scanning plane of the radar 1022 and the plane formed by the lifting-part 103.

[0104] The abovementioned preset angle may be determined according to actual needs, for example, it may be $\pm 15^\circ$ with the plane formed by the lifting-part 103, or $\pm 15^\circ$ with the vertical plane of the plane formed by the lifting-part 103, or other predetermined angles.

[0105] Exemplarily, the camera 13 may be located close to the center position of the spreader 5 about 50 centimeters, so that it can observe multiple positions such as the plane of the spreader 5 and the ground marking line at the same time.

[0106] Exemplarily, the angle sensor 1024 is a three-axis angle sensor, which is of low cost while addressing all the needs.

[0107] FIG.14 is a flowchart of a control method of a lifting device provided by an embodiment of the application, and the method includes the following steps S410-S430.

[0108] S410: obtaining the orientation deviation information between the lifting device and the container.

[0109] S420: determining the angle deviation between the lifting device and the container based on the orientation deviation information between the lifting device and the container.

[0110] S430: controlling the adjustment mechanism to adjust the orientation of the lifting device according to the angle deviation between the lifting device and the container satisfying the preset deviation condition.

[0111] The abovementioned steps of S410 to S430 will be elaborated in detail below, respectively.

[0112] 1): In step S410, the orientation deviation information between the lifting device and the container is obtained based on the lifting device in the above embodiment.

[0113] Exemplarily, the orientation deviation information between the lifting device and the container is detected by at least one of the laser, radar, camera and angle sensor in the electronic guide plate, and the collected orientation deviation information is sent to the controller.

[0114] 2): In step S420, the angle deviation between the lifting device and the container is determined based on the orientation deviation information between the lifting device and the container.

[0115] When the number of electronic guide plates exceeds 4, the angle deviation between the lifting device and the container can be obtained directly through the detected orientation deviation information between the lifting device and the container.

[0116] However, when the number of electronic guide plates is less than 4 but greater than or equal to 2, the detected orientation deviation information between the lifting device and the container cannot reach the required detection accuracy. Based on the orientation deviation information between the lifting device and the container and according to the least squares deviation algorithm, the angle deviation between the spreader and the container can be calculated. The specific implementation method is as following: first, adjusting the spreader appropriately so that there is a reasonable preset deviation between the spreader and the container, and then obtaining the angle deviation between the spreader and the container based on the least square formula.

[0117] Besides, the orientation deviation information of the target container and the load container may also be used to determine the angle deviation between the target container and the load container, and perform subsequent processing. The specific implementation method is as following: first, adjusting the spreader appropriately so that there is a reasonable preset deviation between the target container and the load container, and then obtaining the angle deviation between the target container and the load container based on the least square formula.

[0118] 3): In step S430, controlling the adjustment mechanism to adjust the orientation of the lifting device according to the angle deviation between the lifting device and the container such that the angle deviation between the lifting device and the container satisfying the preset deviation condition.

[0119] Based on the angle deviation between the lifting device and the container, determining whether the angle deviation satisfies the preset angle deviation threshold; if the angle deviation exceeds the preset angle deviation threshold, the adjustment mechanism is controlled to adjust the orientation of the lifting device, so that the angle deviation between the lifting device and containers satisfying the preset deviation condition.

[0120] In one embodiment, the orientation of the lifting device may be adjusted based on the number of ropes of the lifting device. For example, based on the 4-rope and/or 8-rope scheme in the orientation adjustment of the spreader, the adjustment mechanism is controlled to adjust the orientation of the lifting device, so that the angle deviation between the lifting device and the container satisfying the preset deviation condition.

[0121] Exemplarily, by matching the Euclidean distance calculation formula, the adjusted distance value between the spreader and the container edge can be obtained. The value of the adjusted distance is:

$$Sub \min \sum_{i=1}^8 \frac{|A_i x_i + B_i y_i + c_i|}{\sqrt{A_i^2 + B_i^2}}$$

[0122] Line $z_i = A_i x_i + B_i y_i + c_i$ is the line vector of a long-side or a short-side of the target box. The (x_i, y_i) in this formula is the projection point in the target container coordination system from the point laser of each spreader in the spreader coordinate system and obtained by the three-axis angle sensor in the electronic guide plate.

[0123] Exemplarily, the 4-rope and/or 8-rope scheme in the spreader orientation adjustment is shown below.

[0124] According to the degree of freedom analysis, the orientation of the spreader is completely determined by the rope length in the lifting-part. Taking the Euler matrix of the spreader as $\vec{R}_{ws}$, the Euler matrix of the container as $\vec{R}_{wt}$, the lifting point position on the container as $\vec{A}_t$, the lifting point position on the spreader as $\vec{B}_s$, the coordinates origin as $O_t = (0,0,0)$, the origin of the spreader coordinates as $\vec{O}_s$, and the effective length vector as $\vec{l}_s$, the following expression can be obtained:

$$\vec{R}_{wt} \vec{B} + \vec{O}_s - \vec{R}_{ws} \vec{A} - \vec{I}_i = 0$$

[0125] which can be converted to:

$$R_{wt}^t B_i + {}^w O_s - R_{ws}^s A_i - {}^w I_i = 0$$

that is:

$${}^w I_i - R_{wt}^t B_i = {}^w O_s - R_{ws}^s A_i;$$

[0126] Thus the adjustment amount for the rope length can be obtained, thereby the orientation of the lifting device can be adjusted, so that the angle deviation between the lifting device and the container satisfying the preset deviation condition.

[0127] The present application provides a control method of a lifting device for controlling the above spreader. The control method of a lifting device includes: obtaining the orientation deviation information between the lifting device and the container; determining the orientation deviation information between the lifting device and the container based on the angle deviation between the lifting device and the container; controlling the adjustment mechanism to adjust the orientation of the lifting device according to the angle deviation between the lifting device and the container such that the angle deviation between the lifting device and the container satisfying the preset deviation condition.

[0128] In the present application, by connecting different electronic guide plates to different lifting-part mounting parts, the orientation deviation information between the spreader and the container is detected, and the adjustment mechanism is controlled to adjust the orientation of the spreader, which greatly improves the adjustment efficiency of the lifting device and shortens the time required for the adjustment process.

[0129] FIG. 15 is a schematic diagram of a lifting control device provided by an embodiment of the application for controlling the abovementioned spreader. The lifting control device includes: an acquisition module 41, a determination module 42, and a controlling module 43.

[0130] The acquisition module 41 is configured for obtaining the orientation deviation information between the lifting device and the container.

[0131] The determination module 42 is configured for determining the angle deviation between the lifting device and the container based on the orientation deviation information between the lifting device and the container.

[0132] The controlling module 43 is configured for controlling the adjustment mechanism based on the angle deviation between the lifting device and the container, and adjusting the orientation of the lifting device, so that the angle deviation between the lifting device and the container satisfying the preset deviation condition.

[0133] The present application provides a lifting control device for controlling the abovementioned spreader. The lifting control device obtains the orientation deviation information between the lifting device and the container through an acquisition module, and based on the orientation deviation information between the lifting device and the container, the determination module determines the angle deviation between the lifting device and the container. The controlling module controls the adjustment mechanism based on the angle deviation between the lifting device and the container, and adjusts the orientation of the lifting device such that the angle deviation between the lifting device and the container satisfying the preset deviation condition.

[0134] In the present application, by connecting different electronic guide plates to different lifting-part mounting parts, the orientation deviation information between the spreader and the container is detected, and the adjustment mechanism is controlled to adjust the orientation of the spreader, which greatly improves the adjustment efficiency of the lifting device, and shortens the time required for the adjustment process.

[0135] In one embodiment, the determination module 42 is configured for determining the angle deviation between the lifting device and the container based on the orientation deviation information between the lifting device and the container, and is specifically implemented as following:

[0136] when the number of electronic guide plates is less than 4, but greater than or equal to 2, based on the orientation deviation information between the lifting device and the container, the angle deviation between the spreader and the container is calculated based on the least squares deviation algorithm.

[0137] In one embodiment, the controlling module 43 is configured to control the adjustment mechanism based on the angle deviation between the lifting device and the

container, and adjust the orientation of the lifting device, such that the angle deviation between the lifting device and the container satisfying the preset deviation condition, and is specifically implemented as following:

[0138] determining whether the angle deviation satisfies the preset angle deviation threshold based on the angle deviation between the lifting device and the container; if the angle deviation exceeds the preset angle deviation threshold, the adjustment mechanism is controlled to adjust the orientation of the lifting device, such that the angle deviation between the lifting device and the container satisfying the preset deviation condition.

[0139] In one implementation, the controlling module 43 is configured for controlling the adjustment mechanism based on the angle deviation between the lifting device and the container, and thus adjust the orientation of the lifting device, such that when the angle deviation between the lifting device and the container satisfying the preset deviation condition, the controlling module 43 is also implemented in the following:

[0140] controlling the adjustment mechanism to adjust the orientation of the lifting device, based on the 4-rope and/or 8-rope scheme in the spreader orientation adjustment, such that the angle deviation between the lifting device and the container satisfying the preset deviation condition.

[0141] The embodiment of the present application also provides a computer device 500. As shown in FIG. 16, the structural schematic diagram of the computer device 500 provided by the embodiment of the present application includes:

[0142] a processor 51, a memory 52, and a bus 53; the memory 52 is used to store execution instructions, including internal memory 521 and external memory 522; the memory 521 here is also called internal memory, which is used to store temporarily the operation data in processor 51 and the data that will be exchanged with external memory 522 such as hard disks. The processor 51 exchanges data with the external memory 522 through the memory 521. When the computer device 500 is running, the processor 51 communicates with the memory 52 through the bus 53, so that the processor 51 executes any one of the above embodiments in user mode, for example:

[0143] obtaining the orientation deviation information between the lifting device and the container;

[0144] determining the angle deviation between the lifting device and the container based on the orientation deviation information between the lifting device and the container; and

[0145] controlling the adjustment mechanism to adjust the orientation of the lifting device according to the angle deviation between the lifting device and the container such that the angle deviation between the lifting device and the container satisfying the preset deviation condition.

[0146] In one example, among the instructions executed by the processor 51, based on the orientation deviation information between the lifting device and the container, the determining the angle deviation between the lifting device and the container may include:

[0147] when the number of electronic guide plates is less than 4, but greater than or equal to 2, based on the orientation deviation information between the lifting device and the container, the angle deviation between the spreader and the container is calculated according to the least squares deviation algorithm.

[0148] In one embodiment, among the instructions executed by the processor 51, based on the angle deviation between the lifting device and the container, the controlling the adjustment mechanism to adjust the orientation of the lifting device such that the angle deviation between the lifting device and the container satisfying the preset deviation condition includes:

[0149] determining whether the angle deviation satisfies the preset angle deviation threshold based on the angle deviation between the lifting device and the container. If the angle deviation exceeds the preset angle deviation threshold, the adjustment mechanism is controlled to adjust the orientation of the lifting device, such that the angle deviation between the lifting device and the containers satisfying the preset deviation condition.

[0150] In one embodiment, in the instruction executed by the processor 51, based on the angle deviation between the lifting device and the container, the controlling the adjustment mechanism to adjust the orientation of the lifting device such that the angle deviation between the lifting device and the container satisfying the preset deviation condition includes:

[0151] controlling the adjustment mechanism to adjust the orientation of the lifting device according to the 4-rope and/or 8-rope scheme in the orientation adjustment of the spreader, such that the angle deviation between the lifting device and the container satisfying the preset deviation condition.

[0152] The embodiments in the present application further provide a computer-readable storage medium, where a computer program is stored in the computer-readable storage medium. And when the computer program is running by the processor, the steps will be executed in the abovementioned method embodiments.

[0153] The abovementioned components in different exemplary units may or may not be physically separated, and the components displayed as units may or may not be physical units, that is, the components may be located in one place, or may be distributed among multiple network units. Based on the actual needs, some or all of the units can be selected to achieve the purpose of the solution in this embodiment.

[0154] In addition, each functional unit in each embodiment of the present application can be integrated into one processing unit, or each unit may exist as a single physical unit alone, or two or more units can be integrated into one unit.

[0155] If the functions are implemented in the form of software functional units and sold or used as independent products, the functions may be stored in a processor-executable non-volatile computer-readable storage medium. Based on this understanding, the technical solution of the present application in essence, or the part that contributes to the prior art or the part of the technical solution can be embodied in the form of a software. And the computer software product is stored in a storage medium, including several instructions configured to have a computer device (which may be a personal computer, a server, or a network device, etc.) to execute all or part of the steps of the methods described in the various embodiments of the present application. The abovementioned storage medium includes: U disk, mobile hard disk, read-only memory (ROM), random access memory (RAM), magnetic disk or optical disk and other media that can store program codes.

What is claimed is:

1. A control device of an electronic guide gate, comprising:
 - a first collection device, configured for collecting a first point cloud data;
 - a second collection device, configured for collecting a second point cloud data;and
 - a controller, connected to the first collection device and the second collection device respectively, and being used to control lifting or dropping of the spreader according to at least one of the first point cloud data and the second point cloud data;wherein the first collection device and the second collection device are arranged into the electronic guide plate.
2. The control device of the electronic guide plate according to claim 1, wherein the controller is configured to:
 - obtain a first orientation data according to the first point cloud data;
 - obtain a second orientation data according to the second point cloud data;
 - inspect the first orientation data and/or the second orientation data to obtain an inspection result; and
 - control lifting or dropping of the spreader according to the inspection result.
3. The control device of the electronic guide plate according to claim 2, wherein the controller is configured to:
 - control lifting or dropping of the spreader when the first orientation data and the second orientation data are consistent.
4. The control device of the electronic guide plate according to any one of claims 1-3, furthermore comprising:
 - an angle sensor, configured for collecting rotation angle;wherein the controller is configured to: obtain the first orientation data according to the first point cloud data, or obtain the second orientation data according to the second point cloud data and the rotation angle.

5. The control device of the electronic guide plate according to any one of claims 2 to 4, wherein the controller is configured to:

select the first orientation data that satisfies a preset lift-and-drop condition from the first orientation data, or select the second orientation data that satisfies a preset lift-and-drop condition from the second orientation data, wherein the lift-and-drop condition is a corresponding actual distance within a lift-and-drop distance range; and

control lifting or dropping of the spreader according to the first orientation data that satisfies the preset lift-and-drop condition or the second orientation data that satisfies the preset lift-and-drop condition.

6. The control device of the electronic guide plate according to any one of claims 1 to 5, wherein the first collection device comprises a point laser range finder or a camera, and/or the second collection device comprises a line laser range finder.

7. The control device of the electronic guide plate according to claim 6, wherein an angle deviation between a working plane of the first collection device and a working plane of the second collection device is within a first threshold range, and an angle deviation between a scanning plane of the second collection device and a wire harness of the first collection device is within the first threshold range.

8. The control device of the electronic guide plate according to any one of claims 1 to 7, wherein the angle deviation between the working plane of the second collection device and the projection plane of the first collection device is within a second threshold range.

9. The control device of the electronic guide plate according to any one of claims 1 to 8, wherein the controller is configured to:

filter the first point cloud data and/or the second point cloud data to obtain a first point cloud data satisfying the preset lift-and-drop condition and/or a second point cloud data satisfying a preset lift-and-drop condition, wherein the lift-and-drop condition is a corresponding actual distance within a lift-and-drop distance range;

compare the actual distance with the first preset distance to obtain a distance deviation; and

perform inspection and verification by the first collection device to collect the distance deviation in a vertical downward direction, when the distance deviation is less than or equal to the second preset distance.

10. The control device of the electronic guide plate according to any one of claims 1 to 9, wherein the controller is configured to:

filter the first point cloud data and/or the second point cloud data to obtain the first point cloud data and/or the second point cloud data that satisfies the preset lift-and-drop condition, wherein the lift-and-drop condition is a corresponding actual distance within a lift-and-drop distance range;

compare the actual distance with the first preset distance to obtain a distance deviation; and

when the distance deviation is greater than the second preset distance, the second collection device performs inspection and verifies the above is true, and thus collects the distance deviation in the horizontal orientation.

11. A control method of an electronic guide plate, comprising:

collecting a first point cloud data;

collecting a second point cloud data; and

controlling a spreader to lift or drop according to at least one of the first point cloud data and the second point cloud data.

12. The control method of the electronic guide plate according to claim 11, wherein the controlling the spreader to lift or drop according to at least one of the first point cloud data and the second point cloud data comprises:

obtaining a first orientation data according to the first point cloud data;

obtaining a second orientation data according to the second point cloud data;

inspecting the first orientation data and/or the second orientation data to obtain a inspection result; and

controlling the spreader to lift or drop according to the inspection result.

13. The control method of the electronic guide plate according to claim 12, wherein, the controlling of the spreader to lift or drop according to the inspection result comprises:

controlling the spreader to lift or drop when the first orientation data and the second orientation data being consistent.

14. The control method of the electronic guide plate according to claim 12 or 13, furthermore comprising:

collecting a rotation angle;

wherein the obtaining the second orientation data according to the second point cloud data comprises:

obtaining the second orientation data according to the second point cloud data and the rotation angle.

15. The control method of electronic guide plate according to any one of claims 12 to 14, further comprises:

selecting the first orientation data that satisfies the preset lift-and-drop condition from the first orientation data, or

selecting a second orientation data that satisfies the preset lift-and-drop condition from the second orientation data, wherein the lift-and-drop condition is corresponding to that the actual distance is within the lift-and-drop distance range; and

wherein the inspecting the first orientation data and/or the second orientation data to obtain a inspection result comprises:

inspecting the first orientation data and/or the second orientation data that satisfy the preset lift-and-drop condition to obtain the inspection result.

16. The control method of the electronic guide plate according to any one of claims 11 to 15, further comprises:

filtering the first point cloud data and/or the second point cloud data to obtain the first point cloud data satisfying the preset lift-and-drop condition and/or the second point cloud data satisfying the preset lift-and-drop condition, wherein the preset lift-and-drop condition is corresponding to that the actual distance is within the lift-and-drop distance range;

comparing the actual distance with a first preset distance to obtain a distance deviation; and

performing detection and verification by the first collection device to collect the distance deviation in the vertical downward direction when the distance deviation is less than or equal to a second preset distance;

wherein the preset lift-and-drop condition is corresponding to that the actual distance is within the lift-and-drop distance range;

wherein the controlling a spreader to lift or drop according to at least one of the first point cloud data and the second point cloud data comprises:

controlling the spreader to lift or drop according to the distance deviation in the vertical downward direction.

17. The control method of electronic guide plate according to any one of claims 11 to 16, further comprises:

filtering the first point cloud data and/or the second point cloud data to obtain the first point cloud data satisfying the preset lift-and-drop condition and/or the second point cloud data satisfying the preset lift-and-drop condition;

comparing the actual distance with the first preset distance to obtain a distance deviation; and

performing detection and verification by the second collection device to collect the distance deviation in the horizontal direction when the distance deviation being greater than the second preset distance,

wherein the preset lift-and-drop condition is corresponding to that the actual distance is within the lift-and-drop distance range;

wherein the controlling a spreader to lift or drop according to at least one of the first point cloud data and the second point cloud data comprises:

controlling the spreader to lift or drop according to the distance deviation in the horizontal direction.

18. A lifting device comprising:

a spreader, comprising a spreader body and a plurality of lifting-part mounting parts, the plurality of lifting mounting parts being evenly distributed on a same side of the spreader body, and being configured to mount the lifting part;

a plurality of adjustment mechanisms, connecting to one of the lifting-part mounting parts respectively;

a plurality of electronic guide plates, connecting to one of the lifting-part mounting parts respectively for detecting the orientation information of the spreader, wherein a first collection device and a second collection device are disposed in the electronic guide plate, and the first collection device and the second collection device are used to collect the first point cloud data and the second point cloud data respectively; and

a controller, connecting to the plurality of electronic guide plates and configured to control the adjustment mechanism to adjust the orientation of the spreader based on the orientation information obtained by the electronic guide plates.

19. The lifting device according to claim 18, wherein the orientation information comprises an orientation deviation information between the spreader and the container; the controller is configured to control the adjustment mechanism to adjust the orientation of the spreader based on the orientation deviation information obtained by the electronic guide plates.

20. The lifting device according to claim 18 or 19, wherein the plurality of electronic guide plates comprise: at least one or more of the lasers, radars, cameras and angle sensors.

21. The lifting device according to any one of claims 18 to 20, wherein the plurality of electronic guide plates comprise lasers disposed at a predetermined distance from an outer edge of the spreader.

22. The lifting device according to any one of claims 18 to 21, wherein the plurality of electronic guide plates comprise radars, and an angle between a scanning plane of the radars and a plane on which the lifting-part is located satisfies a preset angle.

23. The lifting device according to any one of claims 18 to 22, wherein the plurality of electronic guide plates comprise cameras, an optical axis of each of the cameras forms a preset angle with a plane on which the lifting-part is located, and a distance between the cameras and an outer edge of the spreader is within a preset distance range.

24. A control method of a lifting device, comprising:

obtaining an orientation deviation information between the lifting device and a container;

determining an angle deviation between the lifting device and the container based on the orientation deviation information between the lifting device and the container; and

controlling an adjustment mechanism to adjust an orientation of the lifting device according to the angle deviation between the lifting device and the container, such that the angle deviation between the lifting device and the container satisfying a preset deviation condition.

25. The control method of the lifting device according to claim 24, wherein the lifting device comprises an electronic guide plate, wherein the determining an angle deviation between the lifting device and the container based on the orientation deviation information between the lifting device and the container comprises:

calculating an angle deviation between the spreader and the container based on the orientation deviation information between the lifting device and the container according to the least square deviation algorithm when the number of the electronic guide plates is less than or equal to 4 and greater than or equal to 2.

26. The control method of the lifting device according to claim 24 or 25, wherein the controlling an adjustment mechanism to adjust an orientation of the lifting device according to the angle deviation between the lifting device and the container, such that the angle deviation between the lifting device and the container satisfying a preset deviation condition comprises:

when the angle deviation exceeds a preset angle deviation threshold, controlling the adjustment mechanism to adjust the orientation of the lifting device to make the angle deviation between the lifting device and the container satisfy the preset deviation condition.

27. The control method of the lifting device according to any one of claims 24 to 26, wherein the controlling an adjustment mechanism to adjust an orientation of the lifting device according to the angle deviation between the lifting device and the container, such that the angle deviation between the lifting device and the container satisfying a preset deviation condition further comprises:

controlling the adjustment mechanism to adjust the orientation of the lifting device according to a 4-rope scheme and/or a 8-rope scheme in an adjustment of the orientation of the spreader, such that the angle deviation between the lifting device and the container satisfies a preset deviation condition.

28. A lifting control device, comprising:

an acquisition module, configured for acquiring an orientation deviation information between the lifting device and the container;

a determining module, configured to determine an angle deviation between the lifting device and the container based on the orientation deviation information between the lifting device and the container; and

a controlling module, configured to control an adjustment mechanism to adjust an orientation of the lifting device according to the angle deviation between the lifting device and the container, such that the angle deviation between the lifting device and the container satisfying a preset deviation condition.

29. The control device of the lifting device according to claim 28, wherein

the lifting device comprises an electronic guide plate, wherein:

the determining module is configured to:

calculate an angle deviation between the spreader and the container based on the orientation deviation information between the lifting device and the container, according to the least square deviation algorithm when the number of the electronic guide plates is less than or equal to 4 and greater than or equal to 2.

30. The control device of the lifting device according to claim 28 or 29, wherein the control module is configured to:

control the adjustment mechanism to adjust the orientation of the lifting device to make the angle deviation between the lifting device and the container satisfy a preset deviation condition when the angle deviation exceeds a preset angle deviation threshold.

31. The control device of the lifting device according to any one of claims 28 to 30, wherein the control module is configured to:

control the adjustment mechanism to adjust the orientation of the lifting device according to a 4-rope scheme and/or a 8-rope scheme in an adjustment of the orientation

of the spreader, such that the angle deviation between the lifting device and the container satisfies a preset deviation condition.

32. A computer device, comprising:

a processor;

a memory; and

a bus;

wherein the memory stores machine-readable instructions executed by the processor, and when the computer device operates, the processor and the memory are communicated with each other by the bus, and the machine readable instructions are used to perform steps of the method of any one of claims 11 to 17, or 24 to 27 when executed by the processor.

33. A computer-readable storage medium, storing a computer program, wherein the computer program is used to perform the method of any one of claims 11 to 17 or 24 to 27.