SORTING SCHEME GENERATION METHOD AND APPARATUS, SORTING METHOD, ELECTRONIC DEVICE AND STORAGE MEDIUM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present disclosure claims priority to Chinese Patent Application No. 202310452856.1, filed on April 17, 2023 and entitled "SORTING SCHEME GENERATION METHOD AND APPARATUS, AND ELECTRONIC DEVICE AND STORAGE MEDIUM", which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The present application relates to the field of logistics technologies, and in particular, to a sorting scheme generation method and apparatus, a sorting method, an electronic device and a storage medium.

BACKGROUND

[0003] In the field of logistics, a sorting device arranged in a Sorting & Distribution Center is used to sort parcels, that is, to classify and pack parcels for different delivery districts, to facilitate subsequent transportation. Before the parcels are sorted by the sorting device, a sorting scheme needs to be formulated for the sorting device, that is, assigning delivery flow directions to compartments at different positions of the sorting device. A delivery flow direction is used to indicate a destination district for receiving. In a related technology, there is a problem of low sorting capacity of a sorting device. Therefore, how to improve the sorting capacity of the sorting device is a technical problem to be urgently resolved in the related technology.

SUMMARY

[0004] In view of the foregoing problem, embodiments of the present application provide a sorting scheme generation method and apparatus, a sorting method, an electronic device, and a storage medium, to improve a sorting capacity of a sorting device.

[0005] According to an aspect of embodiments of the present application, a sorting scheme generation method is provided. The method includes: determining a target compartment quantity for each of a plurality of candidate delivery flow directions based on a total candidate

compartment quantity and historical discharged parcel quantities of a sorting device corresponding to the plurality of candidate delivery flow directions; performing iterative calculation based on distribution information of the sorting device, distribution information of bundling operation objects and the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, to determine positions, in the sorting device, of compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, so as to make differences between efficiency influence parameters corresponding to different bundling operation objects not exceed a difference threshold value; and generating a sorting scheme for the sorting device based on the positions, in the sorting device, of the compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions.

[0006] According to an aspect of the embodiments of the present application, a sorting scheme generation apparatus is provided. The apparatus includes: a target compartment quantity determining module, configured to determine a target compartment quantity for each of a plurality of candidate delivery flow directions based on a total candidate compartment quantity and historical discharged parcel quantities of a sorting device corresponding to the plurality of candidate delivery flow directions; a position determining module, configured to perform iterative calculation based on distribution information of the sorting device, distribution information of bundling operation objects and the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, to determine positions, in the sorting device, of compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, so as to make differences between efficiency influence parameters corresponding to different bundling operation objects not exceed a difference threshold value; and a sorting scheme generating module, configured to generate a sorting scheme for the sorting device based on the positions, in the sorting device, of the compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions.

[0007] According to an aspect of the embodiments of the present application, an electronic device is provided. The electronic device includes: a processor; and a memory. The memory stores computer-readable instructions, and when the computer-readable instructions are executed by the processor, the sorting scheme generation method is implemented.

[0008] According to an aspect of the embodiments of the present application, a computer-readable storage medium is provided. The computer-readable storage medium stores computer-readable instructions, and when the computer-readable instructions are executed by a processor,

the sorting scheme generation method mentioned above is implemented.

[0009] According to an aspect of an embodiment of the present application, a computer program product is provided, including computer instructions, and when the computer instructions are executed by a processor, the sorting scheme generation method mentioned above is implemented.

[0010] According to an aspect of an embodiment of the present application, a sorting method is provided, including configuring, based on the sorting scheme generation method mentioned above, delivery flow directions for compartments at various positions of a sorting device; and performing sorting of a to-be-sorted batch of parcels based on the delivery flow directions.

[0011] In the present application, a target compartment quantity for each of a plurality of candidate delivery flow directions is first determined based on a total candidate compartment quantity and historical discharged parcel quantities of a sorting device corresponding to the plurality of candidate delivery flow directions; and then iterative calculation is performed based on distribution information of the sorting device, distribution information of bundling operation objects and the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, to determine positions, in the sorting device, of compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, so as to make differences between efficiency influence parameters corresponding to different bundling operation objects not exceed a difference threshold value, so that a sorting scheme for the sorting device is generated.

[0012] For a sorting device, a sorting capacity of the sorting device is affected by delivery flow directions assigned to respective compartments and efficiency of a bundling operation object responsible for bundling. In the present application, influence of candidate delivery flow directions assigned to compartments at different positions on working efficiency of a bundling operation object is considered, so that positions, in the sorting device, of compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions may ensure that differences between efficiency influence parameters corresponding to different bundling operation objects in a corresponding compartment district do not exceed a difference threshold value. Thus, workloads corresponding to respective compartment districts managed by a plurality of bundling operation objects may be basically balanced, thereby avoiding a case where large differences in workloads between the plurality of bundling operation objects affect sorting efficiency of the sorting device. In this way, as delivery flow directions corresponding to compartments at respective positions in the sorting device are assigned according to the sorting scheme obtained from the present application, workloads of

different bundling operation objects may be ensured to be basically the same, so that overall sorting efficiency of the sorting device may be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Accompanying drawings herein included in this specification constitutes a part of the specification, illustrates embodiments conforming to the present application, and are intended to explain principles of the present application together with the specification. Apparently, the accompanying drawings in the following description are merely some embodiments of the present disclosure. Those skilled in the art may still derive other drawings from these accompanying drawings without creative efforts.

[0014] FIG. 1 is a schematic diagram of an application scenario of the present application according to an embodiment of the present application.

[0015] FIG. 2 is a flowchart of a sorting scheme generation method according to an embodiment of the present application.

[0016] FIG. 3 is a flowchart of Step 210 in the embodiment corresponding to FIG. 2.

[0017] FIG. 4 is a flowchart of Step 220 in the embodiment corresponding to FIG. 2.

[0018] FIG. 5 is a flowchart of determining a historical discharged parcel quantity corresponding to each of a plurality of candidate delivery flow directions according to an embodiment of the present application.

[0019] FIG. 6 is a flowchart of determining a candidate delivery flow direction set according to an embodiment of the present application.

[0020] FIG. 7 is a block diagram of a sorting scheme generation apparatus according to an embodiment of the present application.

[0021] FIG. 8 is a schematic structural diagram of an electronic device suitable for implementing an embodiment of the present application.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0022] Exemplary implementations will be described below in detail with reference to the accompanying drawings. Exemplary implementations can be implemented in a variety of forms and should not be construed as limiting to the examples set forth herein. Instead, the implementations are provided to make the present application more comprehensive and complete, and fully convey the concept of the exemplary implementations to those skilled in the art.

[0023] Flowcharts shown in the accompanying drawings are merely exemplary illustrations, and do not necessarily include all content and operations/steps, nor do they have to be executed in an order described. For example, some operations/steps may be further broken down, and some operations/steps may be merged or partially merged. Therefore, an actual execution sequence may change according to an actual situation.

[0024] It should be noted that, the term "a plurality of" mentioned in this specification means two or more; and the term "and/or" is an association relationship that describes associated objects, and represents that there may be three relationships. For example, A and/or B may represent three cases: only A exists, both A and B exist, and only B exists. The character "/" generally indicates "or" relationship between associated objects.

[0025] FIG. 1 is a schematic diagram of an application scenario of the present application according to an embodiment of the present application. As shown in FIG. 1, the application scenario includes a sorting device 110 and an electronic device 120. The sorting device 110 and the electronic device 120 are communicatively connected by using a wired network or a wireless network.

[0026] The sorting device 110 is provided with a conveyor belt 112, and a plurality of compartments 111 are provided on a side of the conveyor belt. The plurality of compartments 111 are distributed along an extension direction of the conveyor belt 112. FIG. 1 exemplarily shows a structure of one sorting device. In FIG. 1, the compartments 111 are distributed on two sides of the conveyor belt 112 of the sorting device. Certainly, in another embodiment, compartments may be provided only on one side of the conveyor belt of the sorting device. One compartment in the sorting device is used to collect a parcel sent to a destination district for receiving indicated by a delivery flow direction. In other words, after a parcel to be sorted is conveyed to the conveyor belt of the sorting device, the sorting device determines, based on a delivery flow direction corresponding to a respective compartment and a receiving address of the parcel, a target compartment for collecting the parcel. When the parcel is moved in the sorting device to a position in communication with the target compartment, the sorting device drives the parcel to fall into a corresponding collection container (for example, a collection bag) from the position, on the conveyor belt, in communication with the target compartment via the target compartment.

[0027] The electronic device 120 may be a server (a physical server or a cloud server), or may be a device that has a specific processing capability, such as an edge computing device. The electronic device 120 may be used to generate a sorting scheme for the sorting device 110 according to the method of the present application, that is, assigning delivery flow directions

to compartments at various positions in the sorting device. After that, the sorting scheme may be sent to the sorting device 110, and the sorting device 110 is used to configure, according to the sorting scheme, the delivery flow directions corresponding to the compartments at various positions, so as to subsequently sort parcels on the conveyor belt based on the configured delivery flow directions.

[0028] The following provides detailed description of implementations of technical solutions in embodiments of the present application.

[0029] FIG. 2 is a flowchart of a sorting scheme generation method according to an embodiment of the present application. The method may be executed by an electronic device having processing capability. Referring to FIG. 2, the method includes at least steps 210 to 230, which are described in detail as follows.

[0030] Step 210: determining a target compartment quantity for each of a plurality of candidate delivery flow directions based on a total candidate compartment quantity and historical discharged parcel quantities of a sorting device corresponding to the plurality of candidate delivery flow directions.

[0031] Generally, before a batch of parcels is conveyed to a conveyor belt of the sorting device, delivery flow directions corresponding to compartments at various positions in the sorting device need to be assigned in advance. One candidate delivery flow direction is used to indicate one receiving destination district. In the present application, a sorting scheme is generated for the sorting device, that is, delivery flow directions corresponding to compartments at various positions in the sorting device are determined, to ensure that sorting pressures of the compartments in the sorting device are substantially the same, thereby improving overall sorting efficiency of the sorting device.

[0032] For different batches of parcels, receiving addresses of the parcels vary. Therefore, delivery flow directions for each batch of parcels need to be specifically configured. For example, if receiving districts of a batch of parcels includes: City A, City B1 in Province B, City B2 in Province B, City C1 in Province C, City C2 in Province C, ..., delivery flow directions set for the batch of parcels may include: City A, City B1 in Province B, City B2 in Province B, City C1 in Province C, City C1 in Province C, ...; if receiving districts of another batch of parcels includes: City D, City E in Province E1, City F1, ..., delivery flow directions set for the other batch of parcels may include City D, City E in Province City E, and City F1, ...

[0033] In some cases, on a basis of dividing delivery districts by city, it is possible that in a specific batch of parcels, actually there are a small number of parcels required to be delivered to a particular city. For example, in one batch of parcels, there are a small number of parcels

required to be delivered to City B1 in Province B, and there are also a small number of parcels required to be delivered to other cities in Province B. In this case, if each city in Province B is determined as a delivery flow direction and a compartment is assigned for the delivery flow direction, utilization efficiency of a compartment corresponding to City B1 in Province B in the sorting device is low. Therefore, in this case, Province B may be determined as a delivery flow direction, rather than a city in Province B being determined as a delivery flow direction.

[0034] As described above, for delivery flow directions, one district obtained based on a district division unit may be determined as a delivery flow direction, or a plurality of districts obtained based on the district division unit may be determined as a delivery flow direction, where the district division unit may be, for example, a city. For example, if there are many parcels to be delivered to City C1 in Province C, City C1 in Province C may be used as a delivery flow direction. If there are a small number of parcels to be delivered to all cities in Province C, Province C may be used as a delivery flow direction. Certainly, a plurality of cities distributed together in Province C may alternatively be used as a delivery flow direction. The district division unit may be set according to an actual requirement, for example, may be a county, a city, a province, or a country, which is not specifically limited herein.

[0035] The total candidate compartment quantity is a quantity of compartments, in the sorting device, to be assigned with delivery flow directions. It should be understood that the total candidate compartment quantity does not exceed a total quantity of compartments in the sorting device. In practice, a receiving address of a parcel may not be accurately identified due to a reason such as scanning, thus failing to accurately determine a delivery flow direction corresponding to a compartment at which the parcel is to be dropped. In this case, in order to prevent the parcel from being conveyed on the conveyor belt of the sorting device all the time, a compartment for collecting an abnormal parcel may be assigned in the sorting device.

[0036] In some other cases, when a parcel is conveyed to a compartment corresponding to a delivery flow direction that corresponds to a receiving address of the parcel, and if a bundling worker at the compartment is bundling, the parcel is not allowed to drop from the corresponding compartment in this case and needs to continue to be conveyed on the conveyor belt of the sorting device. In a case that bundling is performed when the parcel passes through the corresponding compartment for a plurality of times, in order to prevent the parcel from continuing to be conveyed on the conveyor belt and affecting capacity of the sorting device, a compartment needs to be set to collect a parcel whose number of times passing through its corresponding compartment without being discharged exceeds a set threshold value.

[0037] In view of the foregoing case, in some embodiments, a quantity of compartments

assigned with specific functions may be subtracted from a total quantity of compartments in the sorting device, and a result of the subtraction is used as the total candidate compartment quantity. The compartments with specific functions are, for example, the compartment mentioned above for collecting a parcel whose receiving address is not identified and the compartment mentioned above for collecting a parcel whose number of times passing through its corresponding compartment without being discharged exceeds a set threshold. Certainly, in another scenario, other compartments with specified functions may alternatively be assigned according to an actual requirement. It should be noted that, in the present application, the compartment with a specified function is a compartment for which no delivery flow direction is assigned.

[0038] The candidate delivery flow directions refer to delivery flow directions set for a batch of parcels to be sorted, where there are a plurality of candidate delivery flow directions, and a quantity of the candidate delivery flow directions does not exceed the total candidate compartment quantity.

[0039] A historical discharged parcel quantity, corresponding to a candidate delivery flow direction, of a sorting device refers to a quantity of parcels collected in or a quantity of discharged parcels corresponding to a compartment whose assigned delivery flow direction of the sorting device in a historical time period is the candidate delivery flow direction. It should be understood that, for each candidate delivery flow direction, there may be one or more compartments whose assigned delivery flow direction of the sorting device in a historical time period is the candidate delivery flow direction. In a case of more compartments, a historical discharged parcel quantity corresponding to a candidate delivery flow direction of the sorting device is equal to a sum of quantities of discharged parcels corresponding to a plurality of compartments whose assigned delivery flow directions of the sorting device in a historical time period are the candidate delivery flow direction.

[0040] In some embodiments, a quantity proportion of discharged parcels corresponding to each of a plurality of candidate delivery flow directions may be determined based on the historical discharged parcel quantity corresponding to each of the plurality of candidate delivery flow directions in a candidate delivery flow direction set. Specifically, a quantity proportion of discharged parcels corresponding to a candidate delivery flow direction may be calculated according to the following formula:

$$\alpha_i = \frac{k(i)}{K}. \text{ (Formula 1)}$$

[0041] Herein, α_i is a quantity proportion of discharged parcels corresponding to the ith

candidate delivery flow direction; k(i) is a historical discharged parcel quantity corresponding to the ith candidate delivery flow direction; and K is a sum of historical discharged parcel quantities corresponding to the plurality of candidate delivery flow directions in the candidate delivery flow direction set.

[0042] On such a basis, for each candidate delivery flow direction, a product of the total candidate compartment quantity and a quantity proportion of discharged parcels corresponding to the candidate delivery flow direction is used as a target compartment quantity corresponding to the candidate delivery flow direction.

[0043] It should be understood that, a target compartment quantity determined for each candidate delivery flow direction should be a positive integer. However, in practice, the product of the total candidate compartment quantity and the quantity proportion of discharged parcels corresponding to the candidate delivery flow direction may not be an integer. Thus, in this case, a rounding operation is performed on the product of the total candidate compartment quantity and the quantity proportion of discharged parcels corresponding to the candidate delivery flow direction, and a result of the rounding operation is used as the target compartment quantity corresponding to the candidate delivery flow direction.

[0044] In some other embodiments, as shown in FIG. 3, Step 210 includes the following steps.

[0045] Step 310: clustering candidate delivery flow directions based on the historical discharged parcel quantity corresponding to each of the plurality of candidate delivery flow directions, and determining a clustering category of each of the plurality of candidate delivery flow directions.

[0046] The candidate delivery flow direction in a candidate delivery direction set is clustered based on a corresponding historical discharged parcel quantity. In this way, it can be ensured that different candidate delivery flow directions whose corresponding historical discharged parcel quantities have a relatively small difference belong to one category, that is, being used as a clustering category. In a specific embodiment, the plurality of candidate delivery flow directions may be clustered by using a K-means algorithm.

[0047] Step 320: performing average calculation on historical discharged parcel quantities corresponding to candidate delivery flow directions belonging to a same clustering category, to obtain average discharged parcel quantities corresponding to respective clustering categories.

[0048] Step 330: determining, based on the average discharged parcel quantities corresponding to the respective clustering categories, compartment assignment proportions corresponding to candidate delivery flow directions belonging to the respective cluster categories.

[0049] Specifically, the compartment assignment proportions corresponding to the candidate delivery flow directions belonging to the respective cluster categories may be determined based on the following formula:

$$\beta(j) = \frac{\varphi(j)}{K}. \text{ (Formula 2)}$$

[0050] Herein $\beta(j)$ is a compartment assignment proportion corresponding to a candidate delivery flow direction belonging to the jth clustering category; $\varphi(j)$ is an average discharged parcel quantity corresponding to the jth clustering category; and K is a sum of historical discharged parcel quantities corresponding to the respective candidate delivery flow directions in the candidate delivery flow direction set.

[0051] Step 340: determining, based on the total candidate compartment quantity and the compartment assignment proportions corresponding to the candidate delivery flow directions belonging to the respective cluster categories, the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions.

[0052] In some embodiments, if a product of the total candidate compartment quantity and a compartment assignment proportion corresponding to a candidate delivery flow direction belonging to a cluster category is an integer, the product of the total candidate compartment quantity and the compartment assignment proportion corresponding to the candidate delivery flow directions belonging to the cluster category may be used as a target compartment quantity corresponding to the candidate delivery flow direction belonging to the respective cluster category. If a product of the total candidate compartment quantity and a compartment assignment proportion corresponding to a candidate delivery flow direction belonging to a respective cluster category is not an integer, a rounding operation may be performed on the obtained product, and a result of the rounding operation is used as a target compartment quantity corresponding to the candidate delivery flow direction belonging to the respective cluster category.

[0053] In some application scenarios, each delivery flow direction of the sorting device is assigned with a bag tag color. The assigned bag tag color is used to indicate a color assigned to a collection bag used at a compartment corresponding to the delivery flow direction. Meanwhile, there is a limit set for the bag tag color, that is, a preset maximum compartment quantity for each bag tag color (for example, a third quantity described below) is set. In this way, a maximum quantity of compartments for a same bag tag color is defined on the basis of each delivery flow direction being assigned with one bag tag color. In practice, there may be a case in which a quantity of compartments required to be assigned for a delivery flow direction

exceeds the third quantity, and a case in which a quantity of compartments required to be assigned for a delivery flow direction does not exceed the third quantity. Thus, based on the limit for the bag tag color, it is easy to have uneven load distribution in different compartments. To solve the foregoing technical problem to some extent, a quantity of compartments corresponding to a bag tag color may be adjusted according to the following process shown in Step A1 and Step A2.

[0054] Step A1: determining, based on multiplication results of the total candidate compartment quantity and the compartment assignment proportions corresponding to respective cluster categories, target compartment quantities corresponding to candidate delivery flow directions belonging to respective cluster categories.

[0055] For a specific process of determining the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, it can be referred to the foregoing description, and details are not described herein again.

[0056] Step A2: based on an initially assigned one-to-one correspondence between a candidate delivery flow direction and a bag tag color, if there is a first candidate delivery flow direction whose corresponding target compartment quantity exceeds the third quantity, setting a bag tag color corresponding to compartments of the third quantity that correspond to the first candidate delivery flow direction as a bag tag color initially assigned for the first candidate delivery flow direction; and adjusting a bag tag color corresponding to compartments of a fourth quantity that correspond to the first candidate delivery flow direction to a bag tag color corresponding to a second candidate delivery flow direction, where the fourth quantity is equal to a difference between a target compartment quantity corresponding to the first candidate delivery flow direction and the third quantity; and the second candidate delivery flow direction is a candidate delivery flow direction whose corresponding target compartment quantity is less than the third quantity.

[0057] The third quantity may be set based on the limit for the bag tag color. For example, if the limit for the bag tag color indicates that one bag tag color corresponds to a maximum of 16 compartments, the third quantity may be set to 16.

[0058] After the adjustment according to the foregoing process, the first candidate delivery flow direction whose corresponding target compartment quantity exceeds the third quantity corresponds to two bag tag colors. That is, the bag tag color corresponding to the compartments of the third quantity for the first candidate delivery flow direction is a bag tag color initially assigned to the first candidate delivery flow direction, and the bag tag color corresponding to the compartments of the fourth quantity corresponding to the first candidate delivery flow

direction is another bag tag color. Alternatively, it should be understood that, after adjustment, there may be a case where two different candidate delivery flow directions correspond to a same bag tag color.

[0059] For example, if a candidate delivery flow direction set includes five candidate delivery flow directions, which are respectively candidate delivery flow directions P1 to P5, and bag tag colors initially assigned to the candidate delivery flow directions P1 to P5 are respectively green, yellow, blue, black, and purple. Target compartment quantities corresponding to the candidate delivery flow directions P1 to P5 are 20, 13, 17, 12, and 15, respectively. Assuming that the third quantity is 16, it can be seen that the target compartment quantity (20) corresponding to the candidate delivery flow direction P1 and the target compartment quantity (17) corresponding to the candidate delivery flow direction P3 exceed 16. Therefore, the candidate delivery flow direction P1 and the candidate delivery flow direction P3 may be considered as the first candidate delivery flow direction in the present application, and the candidate delivery flow direction P2, the candidate delivery flow direction P4, and the candidate delivery flow direction P5 may be considered as the second candidate delivery flow direction in the present application. Thus, for the candidate delivery flow direction P1, a bag tag color corresponding to 16 compartments that correspond to the candidate delivery flow direction P1 may be maintained as green, and a bag tag color corresponding to 4 compartments that correspond to the candidate delivery flow direction P1 may be set as black (namely, a bag tag color initially assigned to the candidate delivery flow direction P4). Similarly, a bag tag color corresponding to 16 compartments that correspond to the candidate delivery flow direction P3 is maintained as blue, and a bag tag color corresponding to 1 compartment that corresponds to the candidate delivery flow direction P3 is adjusted to yellow (namely, a bag tag color initially assigned to the candidate delivery flow direction P2). In this way, after the adjustment, a quantity of compartments corresponding to the bag tag color of green is 16, a quantity of compartments corresponding to the bag tag color of yellow is 14, a quantity of compartments corresponding to the bag tag color of blue is 16, a quantity of compartments corresponding to the bag tag color of black is 16, and a quantity of compartments corresponding to the bag tag color of purple is 15.

[0060] In some embodiments, in order to avoid secondary adjustment of a bag tag color for a compartment that corresponds to a candidate delivery flow direction, for each first candidate delivery flow direction, a candidate delivery flow direction whose corresponding target compartment quantity is less than a target difference may be used as the second candidate delivery flow direction determined based on the first candidate delivery flow direction, where

the target difference is equal to a difference between the third quantity and the fourth quantity. In this way, it can be ensured that after a bag tag color for part of compartments corresponding to the first candidate delivery flow direction is adjusted to a bag tag color corresponding to the second candidate delivery flow direction, a quantity of compartments corresponding to the bag tag color that corresponds to the second candidate delivery flow direction does not exceed the third quantity.

[0061] Step 220: performing iterative calculation based on distribution information of the sorting device, distribution information of bundling operation objects and the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, to determine positions, in the sorting device, of compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, so as to make differences between efficiency influence parameters corresponding to different bundling operation objects not exceed a difference threshold value.

[0062] The distribution information of the sorting device indicates position information of respective compartments in the sorting device and position information of a printing device arranged in a region where the sorting device is located. The printing device arranged in the region where the sorting device is located is used to print a logistics voucher including identification information of parcels contained in a collection container at a corresponding compartment.

[0063] The distribution information of the bundling operation objects indicates positions of compartments in compartment districts managed by respective bundling operation objects. Generally, a compartment district managed by one bundling operation object includes a plurality of consecutive compartments. The bundling operation object is responsible for bundling a collection bag at a compartment in a corresponding compartment district, printing a logistics voucher for the collection bag, and replacing the collection bag.

[0064] The efficiency influence parameter corresponding to a bundling operation object refers to a parameter that affects working efficiency of the bundling operation object. In a specific embodiment, the efficiency influence parameter includes at least one of a distance between a compartment in a compartment district corresponding to a bundling operation object and a printing device, a movement distance of the bundling operation object, and a relative distance between compartments corresponding to different delivery flow directions belonging to a target delivery flow direction type. The delivery flow direction belonging to the target delivery flow direction type is a candidate delivery flow direction whose corresponding historical discharged parcel quantity is greater than a first quantity.

[0065] In a sorting process, if a collection container (for example, a collection bag) at a compartment is filled, a bundling operation object is required to replace a new collection bag for the compartment, to bundle the filled collection bag, and to print a logistics voucher including identification information of parcels contained in the collection container from the printing device, and to stick the logistics voucher to a surface of the collection bag. It should be understood that, if a distance between a compartment and the printing device is too far, a bundling operation object needs to move a relatively long distance to print the logistics voucher, which reduces efficiency of the bundling operation object. Therefore, in the present application, a distance between a compartment in a compartment district corresponding to the bundling operation object and a printing device is configured as an optimization objective, so that in an obtained sorting scheme, there is little difference between distances from compartments in compartment districts corresponding to different bundling operation objects to the printing device. The distance between a compartment in a compartment district corresponding to a bundling operation object and the printing device may be a total distance that the bundling operation object moves between the compartment in the corresponding compartment district and the printing device in a to-be-sorted batch corresponding to the sorting scheme.

[0066] In some embodiments, for a batch of parcels to be sorted, parcel quantities corresponding to the respective candidate delivery flow directions are different. In other words, in the sorting process, different quantities of collection bags are also required to be replaced at respective compartments. Based on this, the distance from the compartment in the compartment district corresponding to the bundling operation object and the printing device may be a sum of distances obtained, by using a quantity of collection bags required at a compartment as a weighting coefficient, by weighting distances between compartments in the compartment district corresponding to the bundling operation object and the printing device. For example, it is determined, based on preset candidate delivery flow directions and address information of a batch of parcels to be sorted, that quantities of collection bags required at five compartments (a compartment K1, a compartment K2, a compartment K3, a compartment K4 and a compartment K5, respectively) in the compartment district managed by the bundling operation object are S1, S2, S3, S4, and S5, respectively; and distances between the compartment K1 to the compartment K5 in the compartment district managed by the bundling operation object and the nearest printing device are L1, L2, L3, L4, and L5, respectively. In this case, a distance L between the compartments in the compartment district corresponding to the bundling operation object and the printing device is as follows:

$$L = S1*L1 + S2*L2 + S3*L3 + S4*L4 + S5*L5. \text{ (Formula 3)}$$

[0067] Generally, one bundling operation object is responsible for bundling work of a plurality of compartments, printing transport information, replacing collection bags, and the like. If one bundling operation object is responsible for a large quantity of compartments, the bundling operation object is required to move back and forth between compartments at a plurality of positions. In this way, if a moving distance of the bundling operation object is relatively large, physical energy consumption of the bundling operation object is excessively large, which may reduce bundling efficiency of the bundling operation object. Therefore, in the present application, based on such a consideration, a moving distance in a compartment district corresponding to a bundling operation object is considered as an efficiency influence parameter. The moving distance of a bundling operation object in a corresponding compartment district may be considered as a total moving distance between different compartments of the bundling operation object in a sorting batch corresponding to a sorting scheme.

[0068] In some embodiments, as a quantity of collection bags required by each compartment is a quantity of times that the bundling operation object needs to move to the compartment, a moving distance of the bundling operation object in a corresponding compartment district may be determined in combination with the quantities of collection bags required by respective compartments and distances between the compartments. For example, the bundling operation object is responsible for five compartments in a compartment district, which are respectively a compartment K1, a compartment K2, a compartment K3, a compartment K4, and a compartment K5. The compartment K1 is used as a reference point, a distance between the compartment K1 and the compartment K2 is N1, a distance between the compartment K3 and the compartment K1 is N2, a distance between the compartment K4 and the compartment K1 is N3, and a distance between the compartment K5 and the compartment K1 is N4. If it is determined, based on preset candidate delivery flow directions and address information of a batch of parcels to be sorted, that quantities of collection bags required at the compartment K1, the compartment K2, the compartment K3, the compartment K4 and the compartment K5 respectively in the compartment district managed by the bundling operation object are S1, S2, S3, S4, and S5, respectively, it may be determined that a moving distance N of the bundling operation object in the corresponding compartment district is as follows:

$$N = 0*S1 + N1*S2 + N2*S3 + N3*S4 + N4*S5. \text{ (Formula 4)}$$

[0069] It should be understood that, if compartments for different delivery flow directions belonging to the target delivery flow direction type are arranged next to each other, it is easy to appear that compartments with a large quantity of discharged parcels are in a same compartment district managed by one bundling operation object. Thus, a workload is relatively

heavy for the bundling operation object. In addition, the longer the time is, the lower the packing efficiency of the bundling operation object is, thereby affecting sorting efficiency of the sorting device. Therefore, in the present application, a relative distance between compartments for different delivery flow directions belonging to a target delivery flow direction type is used as an efficiency influence parameter, to avoid that compartments, having a large number of discharged parcels, for different delivery flow directions are arranged next to each other.

[0070] In some embodiments, a constraint condition may be further preset. In an iterative calculation process, it is ensured that compartments assigned to respective candidate delivery flow directions meet the constraint condition. The constraint condition includes a constraint on delivery flow direction assignment of the sorting device, a constraint on assignment of compartments corresponding to different delivery flow directions, and a constraint on distances between compartments for different delivery flow directions belonging to the target delivery flow direction type.

[0071] The constraint on delivery flow direction assignment means that a plurality of compartments corresponding to a same delivery flow direction are required to be adjacent to each other, that is, a compartment corresponding to another delivery flow direction is not allowed to be inserted between the compartments corresponding to a same delivery flow direction. This facilitates transport of collection bags in the same delivery flow direction to a next node for transport.

[0072] The constraint on assignment of compartments corresponding to different delivery flow directions means that compartments arranged opposite to each other in the sorting device are assigned with different delivery flow directions. This avoids a case of a floating parcel in the sorting device caused when a same delivery flow direction is assigned to compartments arranged opposite to each other.

[0073] The constraint on distances between compartments of different delivery flow directions belonging to the target delivery flow direction type means that the distances between the compartments for different delivery flow directions belonging to the target delivery flow direction type are less than a first distance, and the compartments for different delivery flow directions belonging to the target delivery flow direction type are not close to each other in the sorting device. In this way, it can be ensured that distances between compartments for different delivery flow directions with a large delivery quantity (that is, a historical discharged parcel quantity is greater than the first quantity) are as small as possible, but the compartments are not adjacent to each other. In this way, it may be avoided that all compartment districts managed

by a bundling operation object are districts where compartments corresponding to delivery flow directions with a large delivery quantity are located, thereby avoiding heavy workloads of the bundling operation object.

[0074] In the present application, the determining the positions, in the sorting device, of compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions means determining which compartments at which positions in the sorting device correspond to which candidate delivery flow directions, to ensure that a compartment quantity finally assigned for each candidate delivery flow direction is the target compartment quantity corresponding to the corresponding candidate delivery flow direction.

[0075] In the present application, iteration is performed based on the distribution information of the sorting device, the distribution information of the bundling operation objects and the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, such that positions, in the sorting device, of compartments of target compartment quantities finally determined for each of the plurality of candidate delivery flow directions make differences between efficiency influence parameters corresponding to different bundling operation objects in corresponding compartment districts do not exceed a difference threshold value, so as to ensure that workloads of different bundling operation objects are substantially the same. This avoids reduction in sorting efficiency of the sorting device caused when efficiency of some bundling operation objects is reduced due to high workloads caused by an inappropriate sorting scheme.

[0076] In some embodiments, the iterative calculation may be performed by using a genetic algorithm and based on the distribution information of the sorting device, the distribution information of the bundling operation objects and the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, to determine the positions, in the sorting device, of compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, so as to make differences between efficiency influence parameters corresponding to different bundling operation objects not exceed a difference threshold value.

[0077] In some embodiments, when a large quantity of compartments are arranged in the sorting device, a solution space is large, which results in an increased amount of calculation. In this case, to further reduce the solution space, on a basis of district division in the sorting device, an optimization problem of distribution (that is, assigning delivery flow directions to compartments at respective positions) of compartments in the whole sorting device may be simplified to an optimization problem of distribution of compartments in a plurality of districts.

[0078] In some embodiments, compartments of the sorting device are distributed in K zones, where K is an integer greater than 1. Correspondingly, the distribution information of the sorting device includes distribution sub-information respectively corresponding to the K zones; and the distribution information of the bundling operation objects includes object distribution sub-information respectively corresponding to the K zones. It should be understood that, for each zone, the distribution sub-information corresponding to each zone indicates positions of respective compartments in the zone and a position of a printing device arranged in the zone. The object distribution sub-information corresponding to a zone at least indicates positions of compartment districts that are respectively managed by bundling operation objects assigned to the zone. In this embodiment, before step 220, the method further includes: assigning the plurality of candidate delivery flow directions to the K zones and determining candidate delivery flow directions assigned to respective zones.

[0079] In a specific embodiment, the candidate delivery flow directions may be assigned to the K zones through a backpack model. The backpack model may be used to perform assignment in combination with quantities of compartments arranged in respective zones and quantities of target compartments corresponding to respective candidate delivery flow directions. It should be understood that, for one candidate delivery flow direction (assuming that the candidate delivery flow direction is a candidate delivery flow direction P1), if the candidate delivery flow direction is assigned to one (assuming that the candidate delivery flow direction is assigned to a zone N1) of the K zones, in a subsequent process, positions of compartments of a target compartment quantity corresponding to the candidate delivery flow direction P1 are determined in a plurality of compartments distributed in the zone N1. In this way, a solution space for the compartments assigned to the candidate delivery flow direction P1 is a plurality of compartments in the zone N1 instead of all zones in the sorting device, so that the solution space may be reduced and computational load may be reduced.

[0080] Specifically, in this embodiment, step 220 includes: performing iterative calculation for each zone by using a genetic algorithm and by using an efficiency influence parameter, of a bundling operation object in the zone, in a corresponding compartment district as an optimization target, and based on target compartment quantity corresponding to each of a plurality of candidate delivery flow directions assigned to the zone, distribution sub-information corresponding to the zone, object distribution sub-information corresponding to the zone and a preset constraint condition, to determine positions, in the zone, of compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions assigned to the zone.

[0081] Specifically, as shown in FIG. 4, step 220 includes the following steps.

[0082] Step 410: for each zone, initializing a cluster corresponding to the zone based on the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions assigned to the zone, where each individual in the cluster is a compartment assignment scheme corresponding to the zone, and the compartment assignment scheme indicates candidate delivery flow directions, corresponding to compartments at respective positions in the zone, determined through initialization in the plurality of candidate delivery flow directions assigned to the zone.

[0083] Specifically, if Q compartments are arranged in one zone, an individual in the cluster may be represented by a Q-dimensional vector (that is, a Q-dimensional vector is used to represent a compartment assignment scheme corresponding to the zone). One dimension in the Q-dimensional vector represents a compartment at one position in the zone, and a value of each dimension in the Q-dimensional vector is used to indicate a candidate delivery flow direction initially assigned to the compartment at a corresponding position. It should be understood that, a corresponding value in the Q-dimensional vector indicates that a quantity of dimensions of a candidate delivery flow direction is equal to a target compartment quantity corresponding to the candidate delivery flow direction.

[0084] For example, if 50 compartments are arranged in one zone, candidate delivery flow directions assigned to the zone include a candidate delivery flow direction P1, a candidate delivery flow direction P2, and a candidate delivery flow direction P3, where a target compartment quantity corresponding to the candidate delivery flow direction P1 is 16, a target compartment quantity corresponding to the candidate delivery flow direction P2 is 15, and a target compartment quantity corresponding to the candidate delivery flow direction P3 is 17. An individual in a cluster corresponding to the zone may be represented as a 50-dimensional vector. If a numeral 1 represents the candidate delivery flow direction P1, a numeral 2 represents the candidate delivery flow direction P2, a numeral 3 represents the candidate delivery flow direction P3, and a numeral 0 represents an unassigned delivery flow direction, in a 50-dimensional vector representing an individual, a quantity of dimensions corresponding to a value of 1 is 16 (namely, the target compartment quantity corresponding to the candidate delivery flow direction P1), a quantity of dimensions corresponding to a value of 2 is 15, a quantity of dimensions corresponding to a value of 3 is 17, and a quantity of dimensions corresponding to a value of 0 is 2.

[0085] Step 420: calculating, based on the constraint condition, a fitness function, the distribution sub-information corresponding to the zone, and the object distribution sub-

information corresponding to the zone, fitness degrees corresponding to respective individuals in the cluster, where the fitness function is related to the efficiency influence parameter of the bundling operation object in the zone.

[0086] Specifically, in this embodiment, the fitness function may be expressed as follows:

$$f(y) = \begin{cases} g(y); & z(y) = 0 \\ -\infty; & z(y) \neq 0 \end{cases}. \text{ (Formula 5)}$$

[0087] Herein $f(y)$ denotes a fitness degree of an individual y; $z(y) = 0$ represents that the individual y meets the constraint condition, that is, a compartment assignment scheme represented by the individual y meets the constraint condition defined above; $z(y) \neq 0$ represents that individual y does not meet the constraint condition; and $g(y)$ denotes a function for scoring, in combination with the efficiency influence parameter corresponding to a bundling operation object, the compartment assignment scheme represented by the individual y. For example, if the efficiency influence parameter includes three parameters of a distance between a compartment in a compartment district corresponding to a bundling operation object and a printing device, a movement distance of the bundling operation object, and a relative distance between compartments corresponding to different delivery flow directions belonging to a target delivery flow direction type, then $g(y)$ is a function for scoring the compartment assignment scheme represented by the individual y from the following three dimensions: the distance between the compartment in the compartment district corresponding to the bundling operation object in the district and the printing device, the movement distance of the bundling operation object, and the relative distance between compartments corresponding to different delivery flow directions belonging to the target delivery flow direction type. It should be understood that, when $z(y) = 0$, a value of $g(y)$ is the fitness degree of the individual y.

[0088] Step 430: performing, based on the fitness degrees corresponding to the respective individuals in the cluster, a genetic operation on the individuals in the cluster, to update the cluster.

[0089] The genetic operation includes a crossover operation and a mutation operation, where the crossover operation refers to cross (interchange) elements of part of dimensions in vectors represented by different individuals in the cluster, to obtain new and different individuals.

[0090] For example, if a vector corresponding to an individual y1 in a cluster is (1, 1, 1, 2, 2, 3, 3, 3, 0, 0), and a vector corresponding to an individual y2 is (0, 0, 1, 1, 1, 2, 2, 3, 3, 3), when elements corresponding to the last three dimensions in the vector corresponding to the individual y1 are crossed with elements corresponding to the last three dimensions in the vector corresponding to the individual y2, then two new vectors are obtained, that is, (1, 1, 1, 2, 2, 3,

3, 3, 3, 3) and (0, 0, 1, 1, 1, 2, 2, 3, 0, 0), and the two new vectors are used as new individuals.

[0091] The mutation operation is to randomly change one element or more elements in a vector corresponding to an individual. For example, for a vector (1, 1, 1, 2, 2, 3, 3, 3, 0, 0) corresponding to an individual y1, when a value corresponding to the fourth dimension is changed to 0, a new vector (1, 1, 1, 0, 2, 3, 3, 3, 0, 0) is obtained, and the new vector correspondingly becomes a new individual.

[0092] It may be learned from the foregoing description that a new individual may be obtained by performing a genetic operation on an individual in a cluster, and the obtained individual becomes a new-generation cluster.

[0093] In a specific embodiment, a crossover policy and a mutation policy may be preset to perform the crossover operation and the mutation operation on individuals in each generation of cluster. The crossover policy is, for example, selecting, from a previous generation of cluster, an individual whose fitness degree exceeds a first proportion in a first threshold, to perform a crossover operation. The first proportion may be referred to as a crossover rate. The mutation strategy is, for example, selecting, from a previous generation of cluster, an individual whose fitness degree exceeds a second proportion in a second threshold, to perform a mutation operation. The second ratio may be referred to as a mutation rate. The first proportion and the second proportion may be set according to an actual requirement, and neither of the first proportion nor the second proportion exceeds 1.

[0094] Step 440: determining whether an iteration end condition is met; if no, returning to step 420; otherwise, performing step 450.

[0095] The iteration end condition may be that a quantity of generations of cluster inheritance reaches a specific threshold, or may be that a fitness function corresponding to a cluster converges.

[0096] Step 450: outputting a compartment assignment scheme corresponding to an individual having a highest fitness degree in the cluster, where the output compartment assignment scheme indicates the candidate delivery flow directions corresponding to the compartments at the respective positions in the zone.

[0097] For each zone, iterative calculation may be performed according to the process shown in FIG. 4, to determine candidate delivery flow directions corresponding to compartments at respective positions in each zone. Certainly, iterative calculation may also be performed on a plurality of zones in parallel, to shorten calculation duration.

[0098] In another embodiment, if a quantity of compartments arranged in the sorting device is relatively small, calculation for a zone may not be performed. A district in which all

compartments in the sorting device are located may be configured as a zone, and the candidate delivery flow directions corresponding to the compartments at the respective positions in the sorting device may be determined according to the processes shown in FIG. 4.

[0099] Step 230: generating a sorting scheme for the sorting device based on the positions, in the sorting device, of the compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions.

[0100] It should be understood that, after the positions, in the sorting device, of the compartments of the target compartment quantities corresponding to all candidate delivery flow directions in the candidate delivery flow direction set are determined, the sorting scheme of the sorting device is correspondingly determined. After step 230, the sorting scheme may be sent to the sorting device to be applied in a sorting process for a next time period, that is, delivery flow directions corresponding to compartments at respective positions in the sorting device are assigned according to the sorting scheme.

[0101] In the present application, a target compartment quantity for each of a plurality of candidate delivery flow directions is first determined based on a total candidate compartment quantity and historical discharged parcel quantities of a sorting device corresponding to the plurality of candidate delivery flow directions; and then iterative calculation is performed based on distribution information of the sorting device, distribution information of bundling operation objects and the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, to determine positions, in the sorting device, of compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, so as to make differences between efficiency influence parameters corresponding to different bundling operation objects not exceed a difference threshold value, so that a sorting scheme for the sorting device is generated. Thus, it may be ensured that, when assignment is performed based on the sorting scheme and the distribution information of the bundling operation objects, the efficiency influence parameters of different bundling operation objects are substantially the same. That is, workloads of different bundling operation objects are substantially the same in a sorting process. Therefore, a case of low overall sorting efficiency of the sorting device caused by large differences in workloads of different bundling operation objects may be avoided.

[0102] For a sorting device, a sorting capacity of the sorting device is affected by delivery flow directions assigned to respective compartments and efficiency of a bundling operation object responsible for bundling. In a related technology, a sorting scheme is mainly formulated manually, and an impact of a bundling operation object on the sorting capacity of the sorting

device is not considered, causing a relatively low sorting capacity of the sorting device. In the present application, influence of candidate delivery flow directions assigned to compartments at different positions on working efficiency of a bundling operation object is considered, so that positions, in the sorting device, of compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions may ensure that differences between efficiency influence parameters corresponding to different bundling operation objects in a corresponding compartment district do not exceed a difference threshold value. Thus, workloads corresponding to respective compartment districts managed by a plurality of bundling operation objects may be basically balanced, thereby avoiding a case where large differences in workloads between the plurality of bundling operation objects affect sorting efficiency of the sorting device. In this way, as delivery flow directions corresponding to compartments at respective positions in the sorting device are assigned according to the sorting scheme obtained from the present application, sorting efficiency of the sorting device may be improved.

[0103] In some embodiments of the present application, factors that affect the sorting capacity of the sorting device are decoupled, that is, part of factors are irrelevant to the bundling operation objects, and the other part of factors are relevant to the bundling operation objects. The factors irrelevant to the bundling operation objects include delivery flow directions to be assigned (namely, the candidate delivery flow directions in the present application), a quantity of compartments to be assigned (namely, the total candidate compartment quantity), a quantity of compartments assigned for different delivery flow directions. The factors relevant to the bundling operation objects include positions of compartments corresponding to different delivery flow directions. In the present application, the target compartment quantity corresponding to each of a plurality of candidate delivery flow directions are first determined based on the factors irrelevant to the bundling operation objects; and then iterative calculation is performed based on the factors relevant to the bundling operation objects and in combination with the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions and the distribution information of the sorting device, to specifically determine the positions of the compartments corresponding to the respective candidate delivery flow directions. Thus, compartment distribution optimization is implemented through decoupling and simplification, and the sorting scheme is generated in combination with various factors that affect the sorting capacity of the sorting device. Thus, delivery flow directions corresponding to compartments at respective positions in the sorting device are assigned according to the sorting scheme obtained from the present application, which may improve a

sorting capacity of the sorting device, thereby improving sorting efficiency of the sorting device.

[0104] In some embodiments, the historical discharged parcel quantity corresponding to each of the plurality of candidate delivery flow directions of the sorting device in the candidate delivery flow direction set may be determined based on processes shown in FIG. 5. As shown in FIG. 5, the process includes the following steps.

[0105] Step 510: acquiring historical sorting data of the sorting device, where the historical sorting data includes historical discharged parcel quantities for respective compartments of the sorting device in a historical time period and delivery flow directions corresponding to the respective compartments, where a compartment is used to collect parcels sent to a destination district for receiving indicated by a delivery flow direction.

[0106] The historical discharged parcel quantities for respective compartments in the historical sorting data refer to quantities of parcels collected by the respective compartments in the historical time period. The historical time period may be a time period from start of sorting to completion of sorting for a batch of historical parcels. The delivery flow directions corresponding to the respective compartments in the historical sorting data refers to delivery flow directions assigned to compartments in the sorting device in a historical time period.

[0107] Step 520: determining, based on the historical discharged parcel quantities for the respective compartments and the delivery flow directions corresponding to the respective compartments in the historical sorting data, the historical discharged parcel quantity corresponding to each of the plurality of candidate delivery flow directions.

[0108] In the historical time period, there may be a plurality of compartments assigned to each delivery flow direction, and there may also be candidate delivery flow directions in a candidate delivery flow direction set in the historical time period. On such a basis, if the delivery flow directions in the historical sorting data includes the candidate delivery flow directions, for each candidate delivery flow direction, historical discharged parcel quantities corresponding to compartments whose corresponding delivery flow directions are the candidate delivery flow direction in the historical sorting data are added up, and a result of the addition is used as a historical discharged parcel quantity corresponding to the candidate delivery flow direction.

[0109] In some embodiments, the candidate delivery flow directions may be determined based on processes shown in FIG. 6. As shown in FIG. 6, the process includes steps 610 to 630. The details are as follows:

[0110] Step 610: acquiring a first sorting scheme corresponding to the sorting device, wherein the first sorting scheme indicates delivery flow directions initially assigned to respective

compartments in the sorting device.

[0111] The first sorting scheme corresponding to the sorting device may be a sorting scheme formulated by a sorting responsible object for a current batch of parcels to be sorted. It should be understood that, the first sorting scheme indicates a plurality of delivery flow directions set for the batch of parcels to be sorted, and delivery flow directions initially assigned to compartments at various positions in the sorting device.

[0112] Although the first sorting scheme corresponding to the sorting device is formulated by the sorting responsible object in combination with sorting experience of the sorting responsible object, there may still be room for further optimization. Therefore, in the present embodiment, the first sorting scheme is optimized to obtain an optimized sorting scheme.

[0113] Step 620: determining historical discharged parcel quantities, corresponding to respective delivery flow directions in the first sorting scheme, in the historical sorting data.

[0114] Step 630: filtering out a delivery flow direction, corresponding to a historical discharged parcel quantity less than a second quantity, in the first sorting scheme and determining unfiltered delivery flow directions in the first sorting scheme as the plurality of candidate delivery flow directions.

[0115] It should be understood that, if a historical discharged parcel quantity corresponding to one delivery flow direction is less than the second quantity, it indicates that a quantity of parcels required to be sent to the delivery flow direction may be relatively small. Therefore, in the present application, the delivery flow direction in which the corresponding historical discharged parcel quantity in the first sorting scheme is less than the second quantity is filtered out, and the delivery flow directions that are not filtered out in the first sorting scheme are used as the candidate delivery flow directions. The second quantity may be set according to an actual requirement. For example, the second quantity is 0, 1, 2, or the like.

[0116] In some embodiments, before step 210, the method further includes: subtracting a quantity of compartments corresponding to preset functions in the first sorting scheme from a total quantity of compartments in the first sorting scheme, to obtain the total candidate compartment quantity. The compartments with preset functions are, for example, the compartment mentioned above for collecting parcels without being identified and the compartment mentioned above for collecting parcels whose number of times passing through its corresponding compartment without being discharged exceeds a set threshold.

[0117] It should be understood that, the first sorting scheme is formulated by the sorting responsible object based on site sorting experience of a sorting & distribution center. In this embodiment, compartment distribution (that is, delivery flow directions assigned to

compartments) of the sorting device is optimized in combination with the first sorting scheme, the historical sorting data, the distribution information of the bundling operation objects, and a constraint condition of the sorting device, and in consideration with factors of a plurality of schemes, so that the sorting capacity of the sorting device may be improved.

[0118] The following describes apparatus embodiments of the present application, which may be used to execute the method in the foregoing embodiments of the present application. For details not disclosed in the apparatus embodiments of the present application, it can be referred to the foregoing method embodiments of the present application.

[0119] FIG. 7 is a block diagram of a sorting scheme generation apparatus according to an embodiment of the present application. The sorting scheme generation apparatus may be configured in an electronic device to implement the sorting scheme generation method according to the present application. As shown in FIG. 7, the sorting scheme generation apparatus includes: a target compartment quantity determining module 710, configured to determine a target compartment quantity for each of a plurality of candidate delivery flow directions based on a total candidate compartment quantity and historical discharged parcel quantities of a sorting device corresponding to the plurality of candidate delivery flow directions; a position determining module 720, configured to perform iterative calculation based on distribution information of the sorting device, distribution information of bundling operation objects and the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, to determine positions, in the sorting device, of compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, so as to make differences between efficiency influence parameters corresponding to different bundling operation objects not exceed a difference threshold value; and a sorting scheme generating module 730, configured to generate a sorting scheme for the sorting device based on the positions, in the sorting device, of the compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions.

[0120] In some embodiments, the sorting scheme generation apparatus further includes: a historical sorting data acquisition module, configured to acquire historical sorting data of the sorting device, where the historical sorting data includes historical discharged parcel quantities for respective compartments of the sorting device in a historical time period and delivery flow directions corresponding to the respective compartments; and a historical discharged parcel quantity determining module, configured to determine, based on the historical discharged parcel quantities for the respective compartments and the delivery flow directions

corresponding to the respective compartments in the historical sorting data, the historical discharged parcel quantity corresponding to each of the plurality of candidate delivery flow directions.

[0121] In some embodiments, the target compartment quantity determining module 710 includes: a clustering unit, configured to cluster candidate delivery flow directions based on the historical discharged parcel quantity corresponding to each of the plurality of candidate delivery flow directions, and determine a clustering category of each of the plurality of candidate delivery flow directions; an average discharged parcel quantity determining unit, configured to perform average calculation on historical discharged parcel quantities corresponding to candidate delivery flow directions belonging to a same clustering category, to obtain average discharged parcel quantities corresponding to respective clustering categories; a compartment assignment proportion determining unit, configured to determine, based on the average discharged parcel quantities corresponding to the respective clustering categories, compartment assignment proportions corresponding to candidate delivery flow directions belonging to the respective cluster categories; and a target compartment quantity determining unit, configured to determine, based on the total candidate compartment quantity and the compartment assignment proportions corresponding to the candidate delivery flow directions belonging to the respective cluster categories, the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions.

[0122] In some embodiments, the efficiency influence parameter includes at least one of a distance between a compartment in a compartment district corresponding to a bundling operation object and a printing device, a movement distance of the bundling operation object, and a relative distance between compartments corresponding to different delivery flow directions belonging to a target delivery flow direction type; and the delivery flow direction belonging to the target delivery flow direction type is a candidate delivery flow direction whose corresponding historical discharged parcel quantity is greater than a first quantity.

[0123] In some embodiments, compartments of the sorting device are distributed in K zones, where K is an integer greater than 1; and the distribution information of the sorting device includes distribution sub-information respectively corresponding to the K zones; and the distribution information of the bundling operation objects includes object distribution sub-information respectively corresponding to the K zones. The sorting scheme generation apparatus further includes: a first assignment module, configured to assign the plurality of candidate delivery flow directions to the K zones and determining candidate delivery flow directions assigned to respective zones. In this embodiment, the position determining module

720 includes: a position determining unit, configured to perform iterative calculation for each zone by using a genetic algorithm and by using an efficiency influence parameter, of a bundling operation object in the zone, in a corresponding compartment district as an optimization target, and based on target compartment quantity corresponding to each of a plurality of candidate delivery flow directions assigned to the zone, distribution sub-information corresponding to the zone, object distribution sub-information corresponding to the zone and a preset constraint condition, to determine positions, in the zone, of compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions assigned to the zone.

[0124] In some embodiments, the position determining unit includes: an initialization unit, configured to initialize, for each zone, a cluster corresponding to the zone based on the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions assigned to the zone, where each individual in the cluster is a compartment assignment scheme corresponding to the zone, and the compartment assignment scheme indicates candidate delivery flow directions, corresponding to compartments at respective positions in the zone, determined through initialization in the plurality of candidate delivery flow directions assigned to the zone; a fitness degree calculating unit, configured to calculate, based on the constraint condition, a fitness function, the distribution sub-information corresponding to the zone, and the object distribution sub-information corresponding to the zone, fitness degrees corresponding to respective individuals in the cluster, where the fitness function is related to the efficiency influence parameter of the bundling operation object in the zone; a genetic operation unit, configured to perform, based on the fitness degrees corresponding to the respective individuals in the cluster, a genetic operation on the individuals in the cluster, to update the cluster, and repeat the step of the calculating, based on the constraint condition, the fitness function, the distribution sub-information corresponding to the zone, and the object distribution sub-information corresponding to the zone, fitness degrees corresponding to respective individuals in the cluster until an iteration end condition is met; and an output unit, configured to output a compartment assignment scheme corresponding to an individual having a highest fitness degree in the cluster when the iteration end condition is met, where the output compartment assignment scheme indicates the candidate delivery flow directions corresponding to the compartments at the respective positions in the zone.

[0125] In some embodiments, the sorting scheme generation apparatus further includes: a first sorting scheme acquisition module, configured to acquire a first sorting scheme corresponding to the sorting device, where the first sorting scheme indicates delivery flow directions initially

assigned to respective compartments in the sorting device; a determining module, configured to determine historical discharged parcel quantities, corresponding to respective delivery flow directions in the first sorting scheme, in the historical sorting data; and a candidate delivery flow direction set determining module, configured to filter out a delivery flow direction, corresponding to a historical discharged parcel quantity less than a second quantity, in the first sorting scheme and determine unfiltered delivery flow directions in the first sorting scheme as the plurality of candidate delivery flow directions.

[0126] In some embodiments, the sorting scheme generation apparatus further includes: a total candidate compartment quantity determining module, configured to subtract a quantity of compartments corresponding to preset functions in the first sorting scheme from a total quantity of compartments in the first sorting scheme, to obtain the total candidate compartment quantity.

[0127] FIG. 8 is a schematic structural diagram of an electronic device suitable for implementing an embodiment of the present application. The electronic device is configured to execute the sorting scheme generation method according to the present application. As shown in FIG. 8, the electronic device may include: a processor 801, for example, a CPU, a network interface 804, a user interface 803, a memory 805, and a communications bus 802. The communications bus 802 is configured to implement connection and communication between these components. The user interface 803 may include a display screen (Display) and an input unit such as a keyboard (Keyboard). In an embodiment, the user interface 803 may further include a standard wired interface and wireless interface. In an embodiment, the network interface 804 may include a standard wired interface and wireless interface (such as a Wi-Fi interface). The memory 805 may be a high-speed RAM memory, or may be a non-volatile memory (non-volatile memory), for example, a magnetic disk memory. In an embodiment, the memory 805 may alternatively be a storage apparatus independent of the processor 801.

[0128] Those skilled in the art may understand that the structure of the electronic device shown in FIG. 8 does not constitute a limitation to the electronic device. The electronic device may include more or fewer components than those shown in the figures, or a combination of some components, or have different component arrangements.

[0129] As shown in FIG. 8, the memory 805 used as a computer-readable storage medium may include an operating system, a network communications module, a user interface module, and a program for implementing the sorting scheme generation method. In the electronic device shown in FIG. 8, the network interface 804 is mainly configured to communicate with another device, for example, the sorting device 110 in FIG. 1. The user interface 803 is mainly

configured to connect to a client (a user side) and communicate data with the client. The processor 801 may be configured to invoke a program, stored in the memory 805 for implementing the sorting scheme generation method, and perform steps of the sorting scheme generation method in any one of the foregoing method embodiments.

[0130] According to an aspect of embodiments of the present application, a computer-readable storage medium is provided. The computer-readable storage medium stores computer-readable instructions. When the computer-readable instructions are executed by a processor, the sorting scheme generation method in any one of the foregoing method embodiments is implemented.

[0131] It should be noted that, the computer-readable medium described in this embodiment of the present application may be a computer-readable signal medium, a computer-readable storage medium, or any combination of the two. The computer-readable storage medium may be, for example, an electrical, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, or device, or any combination thereof. More specific examples of the computer-readable storage medium may include, but are not limited to: an electrical connection with one or more conducting wires, a portable computer disk, a hard disk, a random access memory (RAM), a read only memory (ROM), an erasable programmable read-only memory (Erasable Programmable Read Only Memory, EPROM), a flash memory, an optical fiber, a portable compact disk read only memory (Compact Disc Read-Only Memory, CD-ROM), an optical storage device, a magnetic storage device, or any suitable combination thereof. In the present application, the computer-readable storage medium may be any tangible medium including or storing a program, and the program may be used by or used in combination with an instruction execution system, apparatus or devices. In the present disclosure, the computer-readable signal medium may include a data signal propagated in a baseband or as a part of a carrier, and computer-readable program code is carried therein. Such a propagated data signal may use a variety of forms including, but not limited to, an electromagnetic signal, an optical signal, or any suitable combination thereof.

[0132] According to an aspect of embodiments of the present application, a computer program product is provided. The computer program product includes computer instructions, and when the computer instructions are executed by a processor, the sorting scheme generation method in any one of the foregoing method embodiments is implemented.

[0133] Those skilled in the art will readily appreciate other implementation solutions of the present application after considering the specification and the implementations disclosed herein. The present application is intended to cover any variations, uses, or adaptations of the present

application that follow the general principles of the present application and include common knowledge or commonly used technical means in the art that are not disclosed herein.

[0134] It should be understood that, the present application is not limited to the precise structures described above and shown in the accompanying drawings, and various modifications and changes may be made without departing from the scope thereof. The scope of the present application is limited only by the appended claims.

CLAIMS

1. A sorting scheme generation method, comprising:

determining a target compartment quantity for each of a plurality of candidate delivery flow directions based on a total candidate compartment quantity and historical discharged parcel quantities of a sorting device corresponding to the plurality of candidate delivery flow directions;

performing iterative calculation based on distribution information of the sorting device, distribution information of bundling operation objects and the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, to determine positions, in the sorting device, of compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, so as to make differences between efficiency influence parameters corresponding to different bundling operation objects not exceed a difference threshold value; and

generating a sorting scheme for the sorting device based on the positions, in the sorting device, of the compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions.

2. The method according to claim 1, before the determining the target compartment quantity for each of the plurality of candidate delivery flow directions based on the total candidate compartment quantity and the historical discharged parcel quantities of the sorting device corresponding to the plurality of candidate delivery flow directions, further comprising:

acquiring historical sorting data of the sorting device, wherein the historical sorting data comprises historical discharged parcel quantities for respective compartments of the sorting device in a historical time period and delivery flow directions corresponding to the respective compartments; and

determining, based on the historical discharged parcel quantities for the respective compartments and the delivery flow directions corresponding to the respective compartments in the historical sorting data, the historical discharged parcel quantity corresponding to each of the plurality of candidate delivery flow directions.

3. The method according to claim 1 or 2, wherein the determining, based on the historical discharged parcel quantities for the respective compartments and the delivery flow directions corresponding to the respective compartments in the historical sorting data, the historical discharged parcel quantity corresponding to each of the plurality of candidate delivery flow directions comprises:

clustering candidate delivery flow directions based on the historical discharged parcel quantity corresponding to each of the plurality of candidate delivery flow directions, and determining a clustering category of each of the plurality of candidate delivery flow directions;

performing average calculation on historical discharged parcel quantities corresponding to candidate delivery flow directions belonging to a same clustering category, to obtain average discharged parcel quantities corresponding to respective clustering categories;

determining, based on the average discharged parcel quantities corresponding to the respective clustering categories, compartment assignment proportions corresponding to candidate delivery flow directions belonging to the respective cluster categories; and

determining, based on the total candidate compartment quantity and the compartment assignment proportions corresponding to the candidate delivery flow directions belonging to the respective cluster categories, the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions.

4. The method according to claim 1, wherein the efficiency influence parameter comprises at least one of a distance between a compartment in a compartment district corresponding to a bundling operation object and a printing device, a movement distance of the bundling operation object, and a relative distance between compartments corresponding to different delivery flow directions belonging to a target delivery flow direction type; and the delivery flow direction belonging to the target delivery flow direction type is a candidate delivery flow direction whose corresponding historical discharged parcel quantity is greater than a first quantity.

5. The method according to any one of claims 1, 2, and 4, wherein compartments of the sorting device are distributed in K zones, wherein K is an integer greater than 1; and the distribution information of the sorting device comprises distribution sub-information respectively corresponding to the K zones; and the distribution information of the bundling operation objects comprises object distribution sub-information respectively corresponding to the K zones;

before the performing iterative calculation based on the distribution information of the sorting device, the distribution information of the bundling operation objects and the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, to determine the positions, in the sorting device, of the compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, so as to make the differences between efficiency influence parameters corresponding to different bundling operation objects not exceed the difference threshold value, the method further comprises:

assigning the plurality of candidate delivery flow directions to the K zones and determining candidate delivery flow directions assigned to respective zones; and

the performing iterative calculation based on the distribution information of the sorting device, the distribution information of the bundling operation objects and the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, to determine the positions, in the sorting device, of the compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, so as to make the differences between efficiency influence parameters corresponding to different bundling operation objects not exceed the difference threshold value comprises:

performing iterative calculation for each zone by using a genetic algorithm and by using an efficiency influence parameter, of a bundling operation object in the zone, in a corresponding compartment district as an optimization target, and based on target compartment quantity corresponding to each of a plurality of candidate delivery flow directions assigned to the zone, distribution sub-information corresponding to the zone, object distribution sub-information corresponding to the zone and a preset constraint condition, to determine positions, in the zone, of compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions assigned to the zone.

6. The method according to claim 5, wherein the performing the iterative calculation for each zone by using the genetic algorithm and by using the efficiency influence parameter, of the bundling operation object in the zone, in the corresponding compartment district as the optimization target, and based on the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions assigned to the zone, the distribution sub-information corresponding to the zone, the object distribution sub-information corresponding to the zone and the preset constraint condition, to determine the positions, in the zone, of compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions assigned to the zone comprises:

for each zone, initializing a cluster corresponding to the zone based on the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions assigned to the zone, wherein each individual in the cluster is a compartment assignment scheme corresponding to the zone, and the compartment assignment scheme indicates candidate delivery flow directions, corresponding to compartments at respective positions in the zone, determined through initialization in the plurality of candidate delivery flow directions assigned to the zone;

calculating, based on the constraint condition, a fitness function, the distribution sub-information corresponding to the zone, and the object distribution sub-information corresponding to the zone, fitness degrees corresponding to respective individuals in the cluster, wherein the fitness function is related to the efficiency influence parameter of the bundling operation object in the zone;

performing, based on the fitness degrees corresponding to the respective individuals in the cluster, a genetic operation on the individuals in the cluster, to update the cluster, and repeating the step of the calculating, based on the constraint condition, the fitness function, the distribution sub-information corresponding to the zone, and the object distribution sub-information corresponding to the zone, fitness degrees corresponding to respective individuals in the cluster until an iteration end condition is met; and

outputting a compartment assignment scheme corresponding to an individual having a highest fitness degree in the cluster when the iteration end condition is met, wherein the output compartment assignment scheme indicates the candidate delivery flow directions corresponding to the compartments at the respective positions in the zone.

7. The method according to claim 5 or 6, wherein the constraint condition comprises at least one of a constraint on delivery flow direction assignment of the sorting device, a constraint on assignment of compartments corresponding to different delivery flow directions, and a constraint on distances between compartments for different delivery flow directions belonging to a target delivery flow direction type.

8. The method according to claim 2, before the determining the target compartment quantity for each of the plurality of candidate delivery flow directions based on the total candidate compartment quantity and the historical discharged parcel quantities of the sorting device corresponding to the plurality of candidate delivery flow directions, further comprising:

acquiring a first sorting scheme corresponding to the sorting device, wherein the first sorting scheme indicates delivery flow directions initially assigned to respective compartments in the sorting device;

determining historical discharged parcel quantities, corresponding to respective delivery flow directions in the first sorting scheme, in the historical sorting data; and

filtering out a delivery flow direction, corresponding to a historical discharged parcel quantity less than a second quantity, in the first sorting scheme and determining unfiltered delivery flow directions in the first sorting scheme as the plurality of candidate delivery flow directions.

9. The method according to claim 8, before the determining the target compartment

quantity for each of the plurality of candidate delivery flow directions based on the total candidate compartment quantity and the historical discharged parcel quantities of the sorting device corresponding to the plurality of candidate delivery flow directions, further comprising:

subtracting a quantity of compartments corresponding to preset functions in the first sorting scheme from a total quantity of compartments in the first sorting scheme, to obtain the total candidate compartment quantity.

10. A sorting scheme generation apparatus, comprising:

a target compartment quantity determining module, configured to determine a target compartment quantity for each of a plurality of candidate delivery flow directions based on a total candidate compartment quantity and historical discharged parcel quantities of a sorting device corresponding to the plurality of candidate delivery flow directions;

a position determining module, configured to perform iterative calculation based on distribution information of the sorting device, distribution information of bundling operation objects and the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, to determine positions, in the sorting device, of compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions, so as to make differences between efficiency influence parameters corresponding to different bundling operation objects not exceed a difference threshold value; and

a sorting scheme generating module, configured to generate a sorting scheme for the sorting device based on the positions, in the sorting device, of the compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions.

11. The sorting scheme generation apparatus according to claim 10, further comprising:

a historical sorting data acquisition module, configured to acquire historical sorting data of the sorting device, wherein the historical sorting data comprises historical discharged parcel quantities for respective compartments of the sorting device in a historical time period and delivery flow directions corresponding to the respective compartments; and

a historical discharged parcel quantity determining module, configured to determine, based on the historical discharged parcel quantities for the respective compartments and the delivery flow directions corresponding to the respective compartments in the historical sorting data, the historical discharged parcel quantity corresponding to each of the plurality of candidate delivery flow directions.

12. The sorting scheme generation apparatus according to claim 10 or 11, wherein the target compartment quantity determining module comprises:

a clustering unit, configured to cluster candidate delivery flow directions based on the historical discharged parcel quantity corresponding to each of the plurality of candidate delivery flow directions, and determine a clustering category of each of the plurality of candidate delivery flow directions;

an average discharged parcel quantity determining unit, configured to perform average calculation on historical discharged parcel quantities corresponding to candidate delivery flow directions belonging to a same clustering category, to obtain average discharged parcel quantities corresponding to respective clustering categories;

a compartment assignment proportion determining unit, configured to determine, based on the average discharged parcel quantities corresponding to the respective clustering categories, compartment assignment proportions corresponding to candidate delivery flow directions belonging to the respective cluster categories; and

a target compartment quantity determining unit, configured to determine, based on the total candidate compartment quantity and the compartment assignment proportions corresponding to the candidate delivery flow directions belonging to the respective cluster categories, the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions.

13. The sorting scheme generation apparatus according to claim 10, wherein the efficiency influence parameter comprises at least one of a distance between a compartment in a compartment district corresponding to a bundling operation object and a printing device, a movement distance of the bundling operation object, and a relative distance between compartments corresponding to different delivery flow directions belonging to a target delivery flow direction type; and the delivery flow direction belonging to the target delivery flow direction type is a candidate delivery flow direction whose corresponding historical discharged parcel quantity is greater than a first quantity.

14. The sorting scheme generation apparatus according to any one of claims 10, 11 and 13, wherein compartments of the sorting device are distributed in K zones, K is an integer greater than 1; and the distribution information of the sorting device comprises distribution sub-information respectively corresponding to the K zones; and the distribution information of the bundling operation objects comprises object distribution sub-information respectively corresponding to the K zones; the distribution information of the bundling operation objects comprises object distribution sub-information respectively corresponding to the K zones; and

the sorting scheme generation apparatus further comprises:

a first assignment module, configured to assign the plurality of candidate delivery

flow directions to the K zones and determine candidate delivery flow directions assigned to respective zones;

the position determining module comprises:

a position determining unit, configured to perform iterative calculation for each zone by using a genetic algorithm and by using an efficiency influence parameter, of a bundling operation object in the zone, in a corresponding compartment district as an optimization target, and based on target compartment quantity corresponding to each of a plurality of candidate delivery flow directions assigned to the zone, distribution sub-information corresponding to the zone, object distribution sub-information corresponding to the zone and a preset constraint condition, to determine positions, in the zone, of compartments of the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions assigned to the zone.

15. The sorting scheme generation apparatus according to claim 14, wherein the position determining unit comprises:

an initialization unit, configured to initialize, for each zone, a cluster corresponding to the zone based on the target compartment quantity corresponding to each of the plurality of candidate delivery flow directions assigned to the zone, wherein each individual in the cluster is a compartment assignment scheme corresponding to the zone, and the compartment assignment scheme indicates candidate delivery flow directions, corresponding to compartments at respective positions in the zone, determined through initialization in the plurality of candidate delivery flow directions assigned to the zone;

a fitness degree calculating unit, configured to calculate, based on the constraint condition, a fitness function, the distribution sub-information corresponding to the zone, and the object distribution sub-information corresponding to the zone, fitness degrees corresponding to respective individuals in the cluster, wherein the fitness function is related to the efficiency influence parameter of the bundling operation object in the zone;

a genetic operation unit, configured to perform, based on the fitness degrees corresponding to the respective individuals in the cluster, a genetic operation on the individuals in the cluster, to update the cluster, and repeat the step of the calculating, based on the constraint condition, the fitness function, the distribution sub-information corresponding to the zone, and the object distribution sub-information corresponding to the zone, fitness degrees corresponding to respective individuals in the cluster until an iteration end condition is met; and

an output unit, configured to output a compartment assignment scheme

corresponding to an individual having a highest fitness degree in the cluster when the iteration end condition is met, wherein the output compartment assignment scheme indicates the candidate delivery flow directions corresponding to the compartments at the respective positions in the zone.

16. The sorting scheme generation apparatus according to claim 10, further comprising:

a first sorting scheme acquisition module, configured to acquire a first sorting scheme corresponding to the sorting device, wherein the first sorting scheme indicates delivery flow directions initially assigned to respective compartments in the sorting device;

a determining module, configured to determine historical discharged parcel quantities, corresponding to respective delivery flow directions in the first sorting scheme, in the historical sorting data; and

a candidate delivery flow direction set determining module, configured to filter out a delivery flow direction, corresponding to a historical discharged parcel quantity less than a second quantity, in the first sorting scheme and determining unfiltered delivery flow directions in the first sorting scheme as the plurality of candidate delivery flow directions.

17. The sorting scheme generation apparatus according to claim 16, further comprising:

a total candidate compartment quantity determining module, configured to subtract a quantity of compartments corresponding to preset functions in the first sorting scheme from a total quantity of compartments in the first sorting scheme, to obtain the total candidate compartment quantity.

18. An electronic device, comprising:

a processor; and

a memory, wherein the memory stores computer-readable instructions, and when the computer-readable instructions are executed by the processor, the method according to any one of claims 1 to 9 is implemented.

19. A computer-readable storage medium, wherein the computer-readable storage medium stores computer-readable instructions, and when the computer-readable instructions are executed by a processor, the method according to any one of claims 1 to 9 is implemented.

20. A sorting method, comprising:

configuring, based on the sorting scheme generation method according to any one of claims 1 to 9, delivery flow directions for compartments at various positions of a sorting device; and

performing sorting of a to-be-sorted batch of parcels based on the delivery flow directions.