

PICKING SYSTEM

FIELD

[0001] The present invention relates to a picking system including an automated warehouse
5 storing multiple mounts each loaded with multiple articles, multiple work areas in which
picking operations are performed, a transport system that transports the mounts between the
automated warehouse and the multiple work areas, and a control system that controls the
automated warehouse and the transport system. Each picking operation is an operation of
10 retrieving, based on order information specifying types and quantities of articles to be shipped
to each shipping destination, the articles of the types and the quantities specified by the order
information from the mounts transferred from the automated warehouse.

BACKGROUND

[0002] In the picking system used in, for example, a distribution center, the mounts loaded
15 with the articles of the types specified by the order information are transported from the
automated warehouse to the work areas. In the work areas, picking operations are performed
to retrieve the articles of the types and quantities specified by the pieces of order information.
Multiple picking operations generated as tasks in the picking system are allocated to the
respective work areas. An example of the picking system is described in Japanese
20 Unexamined Patent Application Publication No. 2015-199562.

CITATION LIST

PATENT LITERATURE

[0003] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2015-
199562
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BRIEF SUMMARY

TECHNICAL PROBLEM

[0004] The automated warehouse in the picking system stores various types of articles.
Shipment frequency or the form of picking operations differs based on the type of articles.
30 When the picking operations associated with the respective pieces of order information are
allocated to appropriate work areas based on the types of articles, the system may achieve more
efficient picking operations as a whole.

[0005] Under such circumstances, a picking system that can improve the efficiency of the
picking operations is awaited.
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SOLUTION TO PROBLEM

[0006] A picking system according to one or more aspects of the present disclosure includes an automated warehouse storing a plurality of mounts each loaded with a plurality of articles, a plurality of work areas in which a picking operation is performed to retrieve, based on order information specifying types and quantities of articles to be shipped to each shipping destination, the articles of the types and the quantities specified by the order information from at least one mount transferred from the automated warehouse among the plurality of mounts, a transport system that transports the plurality of mounts between the automated warehouse and the plurality of work areas, and a control system that controls the automated warehouse and the transport system. The control system performs a batch generation process of aggregating a set number of pieces of the order information and generating batch operations each including the picking operation corresponding to the aggregated pieces of the order information, an operation allocation process of allocating each of the batch operations generated through the batch generation process to a work area of the plurality of work areas, a transporting process of transporting, to each of the plurality of work areas, at least one mount, among the plurality of mounts, to be used in a corresponding batch operation allocated through the operation allocation process among the batch operations, and an index computation process of computing a similarity index indicating similarity between a plurality of pieces of the order information. In the index computation process, the control system assigns type values to respective types as handling targets to rank the types, sets the type values for the types as the handling targets to cause a type value for each type of the types to be greater than a sum of respective type values for all types ranked lower than the type, and computes a sum of respective type values for all types included in each piece of the order information as the similarity index for the piece of the order information. In the batch generation process, the control system aggregates, in order of closeness in the similarity index, a plurality of pieces of the order information to be processed in a unit period.

[0007] In this structure, a type value for each type of the multiple types is greater than a total of type values for all types ranked lower than the type. A piece of order information including an article of the highest-ranked type, for example, thus has a similarity index greater than a similarity index of a piece of order information indicating a combination of all types other than the highest-ranked type. A piece of order information including no article of the highest-ranked type but an article of the second highest-ranked type, for example, also has a similarity index greater than a similarity index of a piece of order information indicating a combination of all types other than the highest- and second highest-ranked types. In this structure, the batch operations are each generated by aggregating multiple pieces of order information that are close in the similarity index. This can increase the likelihood of

aggregating the picking operations corresponding to the set number of pieces of order information including the articles of the same type into the same batch operation. With the picking operations for the articles of the same type being aggregated in the same batch operation, the picking operations for the articles of the type can be performed together in a single work area. This can improve the efficiency of the picking operations in the work areas. This can also improve the efficiency for transporting the mounts in the transporting process.

[0008] Further features and advantageous effects of the technique according to one or more embodiments of the present disclosure will be apparent from exemplary and nonlimiting embodiments described below with reference to the drawings.

BRIEF DESCRIPTION OF DRAWINGS

[0009] FIG. 1 is a plan view of a picking system.

FIG. 2 is a control block diagram of the picking system.

FIG. 3 is a diagram describing a picking operation.

FIG. 4 is a diagram describing batch operations.

FIG. 5 is a diagram describing a similarity index computation process.

FIG. 6 is a diagram describing similarity index-based rearrangement of pieces of order information.

FIG. 7 is a table showing multiple pieces of order information aggregated through a batch generation process.

DETAILED DESCRIPTION

[0010] A picking system according to an embodiment will be described below with reference to the drawings.

[0011] As shown in FIGs. 1 to 3, a picking system 100 includes an automated warehouse 1 storing multiple mounts 5 each loaded with multiple articles W, multiple work areas 2 in which picking operations are performed, a transport system T that transports the mounts 5 between the automated warehouse 1 and the multiple work areas 2, and a control system 3 that controls the automated warehouse 1 and the transport system T. Each picking operation is an operation of retrieving, based on order information In specifying types and quantities of articles W to be shipped to each shipping destination, the articles W of the types and the quantities specified by the order information In from the mounts 5 transferred from the automated warehouse 1.

[0012] The articles W include industrial products, household items, and food products. The articles W may include finished products or half-finished products. The articles W loaded on the mounts 5 are stored in the automated warehouse 1 and are transported to various

destinations by the transport system T.

[0013] The mounts 5 include containers and pallets. The containers include foldable containers and cardboard boxes. In the present embodiment, the mounts 5 are storage containers to be stored in the automated warehouse 1 (refer to FIG. 3).

5 [0014] Although not shown in detail, the automated warehouse 1 includes storage shelves for storing the mounts 5 and an intra-shelf transporter that transports the mounts 5 in the automated warehouse 1. Examples of the intra-shelf transporter may include a stacker crane, a lifter, a transport cart disposed in each tier of the storage shelf, and a conveyor. The intra-shelf transporter is a part of the transport system T. In the present embodiment, the picking
10 system 100 includes multiple automated warehouses 1. The automated warehouse 1 including a conveyor as the intra-shelf transporter may store the mounts 5 on the conveyor. In this case, the automated warehouse 1 may not include a stacker crane or a transport cart.

[0015] In the present embodiment, the transport system T includes a conveyor Ta. The conveyor Ta is a transport path for the mounts 5, connecting the multiple automated warehouses
15 1 and the multiple work areas 2. Each mount 5 transferred from one of the multiple automated warehouses 1 is transported through the transport path of the conveyor Ta to one of the multiple work areas 2. In the picking operations in the work areas 2, the articles W to be shipped are retrieved from the mounts 5. Each mount 5 is then transported through the transport path of the conveyor Ta to one of the multiple automated warehouses 1 and stored. The transport
20 system T may include another type of transporter such as an automated guided vehicle in place of or in addition to the conveyor Ta. As described above, the transport system T includes intra-shelf transporters that transport the mounts 5 in the automated warehouses 1.

[0016] As shown in FIG. 2, the control system 3 controls the automated warehouses 1, the work areas 2, and the transport system T based on the order information In. The control
25 system 3 also controls, for example, instruction output devices (e.g., monitors) or picking robots disposed in the work areas 2.

[0017] The order information In specifies types and quantities of articles W to be shipped to each shipping destination. The order information In is pieces of information generated based on customer requests and accumulated in a server 4. The control system 3 obtains the
30 order information In from the server 4.

[0018] The control system 3 performs inventory management of the articles W in the automated warehouses 1. The control system 3 at least manages the types and the quantities of the articles W loaded on the respective mounts 5 stored in the automated warehouses 1.

[0019] The control system 3 selects, based on the order information In, one or more mounts
35 5 to be used in the picking operation in the respective work areas 2. The one or more selected mounts 5 are transported to the respective work areas 2 by the transport system T.

[0020] The control system 3 may include multiple items of hardware or multiple items of software. The control system 3 includes, for example, a processor such as a microcomputer and peripheral circuitry such as a memory. The functions of the components are implemented by the above hardware and a program executable on a processor such as a computer operating in cooperation with each other.

[0021] The picking operations performed in the work areas 2 will now be described.

[0022] As shown in FIG. 3, each picking operation is performed based on the order information In. The picking operation aggregates one or more articles W specified by the order information In. For example, a piece of order information In is generated for each shipping destination. Each picking operation may thus be an operation of aggregating the articles W requested for the corresponding shipping destination.

[0023] One or more mounts 5 loaded with the articles W of the types and the quantities specified by the piece of order information In are transported to a particular work area 2. The articles W corresponding to the piece of order information In are retrieved and aggregated into a shipping container 6 in the picking operation.

[0024] In the example shown in FIG. 3, a piece of order information In specifies three articles W of type A (hereafter may be referred to as articles A), two articles W of type B (hereafter may be referred to as articles B), and one article W of type C (hereafter may be referred to as an article C). In this example, each mount 5 is loaded with a single type of articles W. The mount 5 loaded with three or more articles A, the mount 5 loaded with two or more articles B, and the mount 5 loaded with one or more articles C are transported to a work area 2. The picking operation in the work area 2 aggregates three articles A, two articles B, and one article C into the shipping container 6. The picking operation may be performed by an operator or autonomously by, for example, a picking robot. The picking operation may be performed by both an operator and a picking robot.

[0025] As shown in FIG. 4, the control system 3 (refer to FIG. 2) performs a batch generation process of aggregating a set number of pieces of order information In and generating batch operations each including the picking operations corresponding to the aggregated pieces of order information In, an operation allocation process of allocating each of the multiple batch operations generated through the batch generation process to one of the multiple work areas 2, and a transporting process of transporting, to each of the multiple work areas 2, the mounts 5 to be used in the corresponding batch operation allocated through the operation allocation process.

[0026] FIG. 4 shows examples of four batch operations. The four batch operations are each allocated to one of four work areas 2 through the operation allocation process. Each batch operation includes the picking operations associated with the set number of pieces of

order information In. In other words, each batch operation includes the set number of picking operations. The set number is not determined uniformly. As shown in FIG. 4, a single batch operation may include two, three, or four picking operations. In other words, the set number is any of 2 to 4 in the example shown in FIG. 4. The set number may be flexibly set as appropriate, or may be a constant number that is unchangeable.

[0027] As shown in FIG. 5, the control system 3 performs an index computation process of computing a similarity index Ex that indicates similarity between the multiple pieces of order information.

[0028] In the index computation process, the control system 3 ranks the types by assigning type values Va to the types of the articles W being handled. In the index computation process, the control system 3 sets the type values Va for the types being handled to cause a type value Va for each type to be greater than the sum of the type values Va for all types ranked lower than the type.

[0029] As shown in, for example, FIG. 5, the articles W include types A to F that are ranked 1 to 6, respectively. For type A, the type value Va is 32. For types B to F that are ranked lower than type A, the sum of the type values Va is 31 ($= 16 + 8 + 4 + 2 + 1$), which is less than 32. For type D, for example, the type value Va is 4. For types E and F that are ranked lower than type D, the sum of the type values Va is 3 ($= 2 + 1$), which is less than 4. In other words, the control system 3 sets the type values Va for the types being handled by setting a type value Va for each type that is referred to as a target type (featured type) to cause the type value Va to be greater than the sum of the type values Va for all types ranked lower than the target type.

[0030] In the present embodiment, each type value Va is M to the power of N , where M is an integer of 2 or greater and N is an integer of 0 or greater. N is a value corresponding to a ranked place. In this manner, the type values Va can be set easily with a type value Va for each type of the multiple types being greater than the sum of the type values Va for all types ranked lower than the type. In this example, M is 2. N is a value greater for a type ranked higher, and is any of 0 to 5 in this example. Specifically, N is the number of types of the articles W being handled (6 in this example) minus the number indicating the place of the articles W of each type in the order (e.g., 1 for the highest-ranked type). The type values Va for the respective types are thus expressed as 2 to the power of 0 to 5.

[0031] In the present embodiment, the ranking is based on order of shipment frequency specified by the pieces of order information In. A type shipped more frequently is ranked higher, and a type shipped less frequently is ranked lower. In other words, the types are ranked based on requests. A type requested more frequently is ranked higher, and a type requested less frequently is ranked lower.

[0032] In the index computation process, the control system 3 computes a total value of the

type values V_a for all types included in each piece of order information In as a similarity index Ex for the piece of order information In . Each type value V_a is a decimal number. Thus, the sum of the type values V_a is a decimal number.

[0033] In the present embodiment, the control system 3 provides a similarity index Ex of a binary number in the index computation process. In the present embodiment, the control system 3 converts the total value of the type values V_a from a decimal number to a binary number. This can simplify the similarity index Ex for computation, and is likely to reduce the computation load on the control system 3.

[0034] In the example shown in FIG. 5, a piece of order information In specifies four articles W of type A, two articles W of type C, and one article W of type D. In this case, the piece of order information In includes the articles W of types A, C, and D. The table in an upper part of FIG. 5 shows that type A has a type value V_a of 32, type C has a type value V_a of 8, and type D has a type value V_a of 4. Thus, the sum of these type values V_a is 44. The control system 3 converts the sum to a binary number and obtains a six-digit similarity index EX of 101100. In this example, N is any of 0 to 5. Thus, the value converted to a binary number is a six-digit value.

[0035] In the present embodiment, the control system 3 performs a stable sort in the batch generation process as shown in FIG. 6 to sequentially arrange the binary similarity indices Ex of the multiple pieces of order information In to be processed in a unit period in descending order starting from the least significant digit.

[0036] The unit period is determined as appropriate based on the operation and is, for example, one hour. The unit period may be a half day or a day.

[0037] In the example in FIG. 6, seven pieces of order information In are to be processed in the unit period. The control system 3 performs the index computation process to compute a binary similarity index Ex for each of the seven pieces of order information In . The similarity indices Ex of the respective pieces of order information In , or the six-digit similarity indices Ex in binary numbers in this example, are sequentially compared starting from the values in the first digit from the right. A similarity index Ex with a greater value is moved to a higher place. This processing is performed until the values in the last sixth digit from the right are processed.

[0038] In the example shown in FIG. 6, the similarity indices Ex of the seven pieces of order information In are compared for the values in the first digit from the right. The similarity index Ex of the second piece of order information In (a piece of order information In labeled with circled 2 in the figure) has the greatest value and is shifted to the uppermost place.

[0039] The values in the second digit from the right are then compared. The similarity index Ex of the fourth piece of order information In (a piece of order information In labeled

with circled 4 in the figure) and the similarity index Ex of the fifth piece of order information In (a piece of order information In labeled with circled 5 in the figure) have the greatest values. These similarity indices Ex are shifted to the uppermost places without changing the order between these similarity indices Ex.

5 [0040] In the example shown in the figure, this processing is performed until the values in the sixth digit are processed. Finally, the similarity index Ex of the fifth piece of order information In is ranked highest, and the similarity index Ex of the third piece of order information In (a piece of order information In labeled with circled 3 in the figure) is ranked lowest.

10 [0041] In the batch generation process, the control system 3 aggregates, as shown in FIG. 7, the multiple pieces of order information In to be processed in the unit period (the first to seventh pieces of order information In in this example) in order of closeness in the similarity index Ex. For example, the multiple pieces of order information In are aggregated in descending or ascending order of the similarity index Ex by a set aggregation number (two in
15 the example shown in FIG. 7). In the present embodiment, the control system 3 aggregates the multiple pieces of order information In that are close in the order obtained through the stable sort. The batch generation process generates batch operations each including the picking operations associated with the aggregated pieces of order information In.

[0042] In the present embodiment, the control system 3 performs the batch generation
20 process of aggregating pieces of order information In ranked adjacent to one another in order of the similarity index Ex and generating batch operations each including the picking operations associated with the respective pieces of order information In. The control system 3 then performs the operation allocation process to allocate the batch operation to one of the multiple work areas 2.

25 [0043] In the example shown in FIG. 7, the multiple pieces of order information In are aggregated in descending order of the similarity index Ex, and two aggregated pieces of order information In are included in a single batch operation. Specifically, the fifth piece of order information In and the sixth piece of order information In (a piece of order information In labeled with circled 6 in the figure) are ranked adjacent to each other in order of the similarity
30 index Ex. The picking operations associated with these pieces of order information In are included in a single batch operation and allocated to a first work area 2.

[0044] The seventh piece of order information In (a piece of order information In labeled with circled 7 in the figure) and the second piece of order information In are ranked adjacent to each other in order of the similarity index Ex. The picking operations associated with these
35 pieces of order information In are included in a single batch operation and allocated to a second work area 2.

[0045] In this manner, the multiple batch operations generated through the batch generation process are each allocated to one of the multiple work areas 2 through the operation allocation process.

[0046] The picking system 100 described above aggregates multiple pieces of order information In that are close in the similarity index Ex to generate the batch operation. This can increase the likelihood of aggregating the picking operations corresponding to the set number of pieces of order information In including the articles W of the same type into the same batch operation. With the picking operations for the articles W of the same type being aggregated in the same batch operation, the picking operations for the articles W of the same type can be performed together in a single work area 2. This can improve the efficiency of the picking operations in the work areas 2. This can also improve the efficiency for transporting the mounts 5 in the transporting process.

Other Embodiments

[0047] Other embodiments will now be described.

[0048] (1) In the above embodiment, each mount 5 is loaded with a single type of articles W. However, the present disclosure is not limited to this example. At least one or all of the multiple mounts 5 may be loaded with multiple types of articles W.

[0049] (2) In the above embodiment, the types of the articles W are ranked based on order of shipment frequency specified by the pieces of order information In. However, the present disclosure is not limited to this example. The types may be ranked based on the specific characteristics (shapes or wrapping aspects) of the articles W.

[0050] (3) In the above embodiment, the types are ranked with a type shipped more frequently being ranked higher and a type shipped less frequently being ranked lower. However, the present disclosure is not limited to the above example. In contrast to the above example, the types may be ranked to cause a type shipped more frequently to be ranked lower and a type shipped less frequently to be ranked higher.

[0051] (4) In the above embodiment, M for the type value Va is 2. However, the present disclosure is not limited to this example. M can be set to any number and is, for example, 3, 4, or 5.

[0052] (5) In the above embodiment, N is greater for a type ranked higher. However, the present disclosure is not limited to this example. N may be, in contrast to the above example, smaller for a type ranked higher. N may increase or decrease by 2 or 3 based on the place in which each type is ranked.

[0053] (6) The structure described in each of the above embodiments may be combined with any other structures described in the other embodiments unless any contradiction arises. For other structures as well, the embodiments described herein are mere examples in all aspects.

The embodiments may thus be modified variously as appropriate without departing from the spirit and scope of the present disclosure.

Overview of Embodiments

[0054] An overview of the present embodiment is provided below.

5 [0055] A picking system includes an automated warehouse storing a plurality of mounts each loaded with a plurality of articles, a plurality of work areas in which a picking operation is performed to retrieve, based on order information specifying types and quantities of articles to be shipped to each shipping destination, the articles of the types and the quantities specified by the order information from at least one mount transferred from the automated warehouse
10 among the plurality of mounts, a transport system that transports the plurality of mounts between the automated warehouse and the plurality of work areas, and a control system that controls the automated warehouse and the transport system. The control system performs a batch generation process of aggregating a set number of pieces of the order information and generating batch operations each including the picking operation corresponding to the aggregated pieces of the order information, an operation allocation process of allocating each
15 of the batch operations generated through the batch generation process to a work area of the plurality of work areas, a transporting process of transporting, to each of the plurality of work areas, at least one mount, among the plurality of mounts, to be used in a corresponding batch operation allocated through the operation allocation process among the batch operations, and
20 an index computation process of computing a similarity index indicating similarity between a plurality of pieces of the order information. In the index computation process, the control system assigns respective type values to types as handling targets to rank the types, sets the type values for the types as the handling targets to cause a type value for each type of the types to be greater than a sum of respective type values for all types ranked lower than the type, and
25 computes a sum of respective type values for all types included in each piece of the order information as the similarity index for the piece of the order information. In the batch generation process, the control system aggregates, in order of closeness in the similarity index, a plurality of pieces of the order information to be processed in a unit period.

[0056] In this structure, a type value for each type of the multiple types is greater than a
30 total of type values for all types ranked lower than the type. A piece of order information including an article of the highest-ranked type, for example, thus has a similarity index greater than a similarity index of a piece of order information indicating a combination of all types other than the highest-ranked type. A piece of order information including no article of the highest-ranked type but an article of the second highest-ranked type, for example, also has a
35 similarity index greater than a similarity index of a piece of order information indicating a combination of all types other than the highest- and second highest-ranked types. In this

structure, the batch operations are each generated by aggregating multiple pieces of order information that are close in the similarity index. This can increase the likelihood of aggregating the picking operations corresponding to the set number of pieces of order information including the articles of the same type into the same batch operation. With the
5 picking operations for the articles of the same type being aggregated in the same batch operation, the picking operations for the articles of the type can be performed together in a single work area. This can improve the efficiency of the picking operations in the work areas. This can also improve the efficiency for transporting the mounts in the transporting process.

[0057] The types may be ranked based on order of shipment frequency specified by the
10 order information.

[0058] This structure can increase the likelihood of aggregating the picking operations corresponding to the set number of pieces of order information including the articles of types that are close in shipment frequency into the same batch operation. For example, the picking operations for the articles of a type shipped more frequently can be performed in the same work
15 area. This can improve the efficiency for transporting the mounts and the efficiency of operations in the work areas. For example, the picking operations for the articles of the type shipped less frequently can be performed in the same work area. This can reduce the likelihood of operation wait in other work areas resulting from a shortage of the mounts even when fewer mounts are loaded with the articles of the type shipped less frequently.

[0059] Each of the type values may be a value of M to the power of N , where M is an integer of 2 or greater and N is an integer of 0 or greater. N may be a value corresponding to a place in which the types are ranked.

[0060] In this structure, the type values can be set easily with a type value for each type of the multiple types being greater than the sum of the type values for all types ranked lower than
25 the type.

[0061] The similarity index may be a value of a binary number. In the batch generation process, the control system may perform a stable sort to sequentially arrange, in descending order starting from a least significant digit, respective similarity indices of the multiple pieces of the order information to be processed in the unit period, and aggregate multiple pieces of the
30 order information ranked close to one another through the stable sort.

[0062] This structure can simplify the computation of aggregating multiple pieces of order information that are close in the similarity index into the batch generation process. This is likely to reduce the computation load on the control system.

35 INDUSTRIAL APPLICABILITY

[0063] The technique according to one or more embodiments of the present disclosure is

applicable to a picking system.

REFERENCE SIGNS LIST

[0064]

- 5 100 picking system
 - 1 automated warehouse
 - 2 work area
 - 3 control system
 - 5 mount
- 10 T transport system
 - W article
 - In order information
 - Va type value
 - Ex similarity index

CLAIMS

1. A picking system, comprising:
 - an automated warehouse storing a plurality of mounts each loaded with a plurality of articles;
 - 5 a plurality of work areas in which a picking operation is performed, the picking operation being an operation of retrieving, based on order information specifying types and quantities of articles to be shipped to each shipping destination, the articles of the types and the quantities specified by the order information from at least one mount transferred from the automated warehouse among the plurality of mounts;
 - 10 a transport system configured to transport the plurality of mounts between the automated warehouse and the plurality of work areas; and
 - a control system configured to control the automated warehouse and the transport system, the control system being configured to perform
 - a batch generation process of aggregating a set number of pieces of the order
 - 15 information and generating batch operations each including the picking operation corresponding to the aggregated pieces of the order information,
 - an operation allocation process of allocating each of the batch operations generated through the batch generation process to a work area of the plurality of work areas,
 - a transporting process of transporting, to each of the plurality of work areas, at least
 - 20 one mount, among the plurality of mounts, to be used in a corresponding batch operation allocated through the operation allocation process among the batch operations, and
 - an index computation process of computing a similarity index indicating similarity between a plurality of pieces of the order information,
 - the control system being configured to, during the index computation process,
 - 25 assign type values to respective types as handling targets to rank the types,
 - set the type values for the types as the handling targets to cause a type value for each type of the types to be greater than a sum of respective type values for all types ranked lower than the type, and
 - compute a sum of respective type values for all types included in each piece of the
 - 30 order information as the similarity index for the piece of the order information,
 - the control system being configured to, during the batch generation process, aggregate, in order of closeness in the similarity index, a plurality of pieces of the order information to be processed in a unit period.
- 35 2. The picking system according to claim 1, wherein
 - the types are ranked based on order of shipment frequency specified by the order

information.

3. The picking system according to claim 1, wherein
each of the type values is a value of M to the power of N , where M is an integer of 2 or
5 greater and N is an integer of 0 or greater, and
 N is a value corresponding to a place in which the types are ranked.
4. The picking system according to any one of claims 1 to 3, wherein
the similarity index is a value of a binary number, and
10 in the batch generation process, the control system
performs a stable sort to sequentially arrange, in descending order starting from a least
significant digit, respective similarity indices of the plurality of pieces of the order information
to be processed in the unit period, and
aggregates a plurality of pieces of the order information ranked close to one another
15 through the stable sort.