

DESCRIPTION

TITLE OF INVENTION: ARTICLE MANAGEMENT DEVICE,
ARTICLE MANAGEMENT METHOD, AND PROGRAM

TECHNICAL FIELD

[0001] The present invention relates to an article management device, an article management method, and a program, and is particularly suitable for being used for article management.

BACKGROUND ART

[0002] Management of positions of articles, for example, articles of iron or steel including plates is performed.

In a technique described in Patent Literature 1, X-Y coordinates of an overhead traveling crane when lowering a steel plate are registered together with a steel plate number of the steel plate, to thereby manage a position of the steel plate.

[0003] Further, in a technique described in Patent Literature 2, a fixed place for a steel material indicated by three-dimensional coordinates is calculated by a fixed place calculation program based on movements in horizontal and vertical directions of a crane and an operation, for example, load detection, and fixed place information indicating the calculated fixed place is stored by being corresponded to steel material identification information of the steel material.

acquires a captured image of a region including display information displayed on the article; an identification information acquisition unit that acquires identification information of the article; a position derivation unit that derives, based on the captured image acquired by the image acquisition unit, an information display position being a three-dimensional position at which the display information is displayed; and a storage unit that stores the information display position in the article derived by the position derivation unit, in a storage medium in association with the identification information of the article acquired by the identification information acquisition unit and information regarding a position in article of the article, in which the information regarding the position in article of the article is information indicating a position of a region including the display information in a case where a predetermined position in the article is set to a reference.

[0010] An article management method of the present invention being an article management method of managing a position of an article, includes: one or two or more of image acquisition steps of acquiring a captured image of a region including display information displayed on the article; an identification information acquisition step of acquiring identification information of the article; a position derivation step of deriving, based on the

captured image acquired by the image acquisition step, an information display position being a three-dimensional position at which the display information is displayed; and a storage step of storing the information display position in the article derived by the position derivation step, in a storage medium in association with the identification information of the article acquired by the identification information acquisition step, and information regarding a position in article of the article, in which the information regarding the position in article of the article is information indicating a position of a region including the display information in a case where a predetermined position in the article is a reference.

[0011]

[0012] A program of the present invention being a program for making a computer execute processing of managing a position of an article, the program making the computer execute: one or two or more of image acquisition steps of acquiring a captured image of a region including display information displayed on the article; an identification information acquisition step of acquiring identification information of the article; a position derivation step of deriving, based on the captured image acquired by the image acquisition step, an information display position being a three-dimensional position at which the display information is displayed; and a storage step

of storing the information display position in the article derived by the position derivation step, in a storage medium in association with the identification information of the article acquired by the identification information acquisition step and information regarding a position in article of the article, in which the information regarding the position in article of the article is information indicating a position of a region including the display information in a case where a predetermined position in the article is a reference.

BRIEF DESCRIPTION OF DRAWINGS

[0013] [Fig. 1] Fig. 1 is a view explaining an example of a flow of a product in a factory.

[Fig. 2] Fig. 2 is a view illustrating an example of a display region with respect to a plate.

[Fig. 3A] Fig. 3A is a view illustrating an example of display contents by a stencil.

[Fig. 3B] Fig. 3B is a view illustrating an example of display contents by a label.

[Fig. 4] Fig. 4 is a view illustrating an example of a state in which plates are loaded and unloaded into and from a transport ship.

[Fig. 5] Fig. 5 is a view in which a state where a plate is lifted by a cargo handling device is seen from an extending direction of a girder (y-axis direction).

[Fig. 6A] Fig. 6A is a view illustrating a first example of a plate conveyance pattern.

[Fig. 6B] Fig. 6B is a view illustrating a second example of the plate conveyance pattern.

[Fig. 6C] Fig. 6C is a view illustrating a third example of the plate conveyance pattern.

[Fig. 6D] Fig. 6D is a view illustrating a fourth example of the plate conveyance pattern.

in article of the label. Further, the y-z coordinates of a position of a barycenter (or centroid) of each of the components of the respective display items in the display by the label are set to a position of each of the components. Fig. 15 indicates that the y-z coordinates of two vertices 1501a and 1501b of the label correspond to the position in article of the label.

[0091] As described above, in the section of ID in the section of stencil in the section of actual article display in the management table 1300 illustrated in Fig. 13, the information indicating the contents and the positions of the components of the ID 305 included in the display by the stencil is stored. Therefore, as illustrated in Fig. 16A, in the example illustrated in Fig. 14, "5", "6", "3", "4", "9", "7", "-", "0", and "1" are stored in the section of ID in the section of stencil in the section of actual article display, as the contents of the components of the ID 305 included in the display by the stencil. Further, in the section of ID in the section of stencil in the section of actual article display, (Ls1, Ws1), (Ls1, Ws2), (Ls1, Ws3), (Ls1, Ws4), (Ls1, Ws5), (Ls1, Ws6), (Ls1, Ws7), (Ls1, Ws8), and (Ls1, Ws9) are stored as the positions of the components.

[0092] Also in the section of another display item in the section of actual article display, information indicating the contents and the positions of the

the y-axis. Subsequently, the position derivation unit 1206 derives, when the components of the display items by the stencil are seen so that top portions thereof are positioned upward, a position of a vertex, out of vertices of the derived circumscribed rectangle, positioned on the lower left side (the negative direction side of the x-axis and the positive direction side of the y-axis), for example, as the position of the point S in the first captured image. Note that when the display by the label is performed in the first captured image, the position derivation unit 1206 derives, when the components of the display items by the label are seen so that top portions thereof are positioned upward, a vertex positioned on the lower left side, for example, out of vertices of the label having the rectangular shape, as the position of the point S in the first captured image.

[0125] The position of the point Q in the first captured image is a position on a straight line passing through the position of the point S in the first captured image and parallel to the y-axis, and a position corresponding to a center of a horizontal angle of view when performing the image capturing (an angle of view in the y-axis direction). Note that the point Q may also be specified in the following manner, for example. Specifically, laser light is irradiated from the point P by a laser pointer or the like, to thereby display a straight line passing

case, the second image acquisition unit 1209 acquires these pieces of information transmitted from the second image capturing device.

[0141] In the example illustrated in Fig. 19, it is assumed that a plate at the lowermost position out of a plurality of stacked plates is placed on the ground, in order to simplify the explanation. A point D is a vertex at a position closest to the point R, out of vertices of a surface on which the display region 201 by the stencil is formed. A point B is a vertex at a position closest to the point R, out of vertices of a bottom surface of the plate at the lowermost position out of the plurality of stacked plates.

[0142] In Fig. 19, $\angle BRD (= \phi_B)$ and $\angle PRO (= \phi_P)$ are determined based on the positions of the point P, the point B, and the point D in the second captured image, and a principal point of the second captured image, for example. By a straight line connecting the point P in the second captured image and the principal point of the second captured image, a direction in which a line segment RP extends is specified. By a straight line connecting the point B in the second captured image and the principal point of the second captured image, a direction in which a line segment RB extends is specified. By a straight line connecting the point D in the second captured image and the principal point of the second captured image, a direction in which a line segment RD extends is specified. The $\angle BRD (= \phi_B)$ is determined based on

direction) of the display region 201 by the stencil. Note that the third to sixth captured images are acquired by the second image acquisition unit 1209, for example. However, it is also possible to use third to sixth image acquisition units that individually acquire the third to sixth captured images, separately from the second image acquisition unit 1209. In such a case, in the flow chart in Fig. 17, at a timing before the timing of starting the processing in step S1708 and a timing separately from the timing of executing the step of acquiring the second captured image by the second image acquisition unit 1209, a step of individually acquiring the third to sixth captured images is added. Note that when the position in the height direction (z-axis direction) of the display region by the stencil (label) can be specified without acquiring the second captured image and the like, the second image acquisition unit 1209 becomes unnecessary.

[0148] As a fifth example, the position derivation unit 1206 may derive the position in the height direction (z-axis direction) of the display region 201 by the stencil of each of plates 1002a and 1002b placed on a conveyor table 1001, based on a position of the conveyor table 1001 and sizes (thicknesses) stored in the management table 1300 as information of the plates 1002a and 1002b. In such a case, the position of the conveyor table 1001 is previously registered in the article management device 1200.

first captured image, as indicated by a dotted line (virtual line) in Fig. 20A. Fig. 20B is a view illustrating an example of geometrical relation between an inside of the first image capturing device and the display region 201 by the stencil. In Fig. 20B, the position derivation unit 1206 first specifies positions of vertices 2002a to 2002d at four corners of a display region 201' by the stencil captured by an image capturing sensor 2002. Next, the position derivation unit 1206 specifies straight lines 2003a to 2003d being straight lines connecting the vertices 2002a to 2002d at four corners of the display region 201' by the stencil and a principal point FP and extended toward the display region 201 by the stencil. Next, the position derivation unit 1206 specifies a quadrangular pyramid 2001 in which the principal point FP is a vertex, the straight lines 2003a to 2003d are four sides whose one end is the principal point FP, respectively, and dimensions of a bottom surface are lengths in the real space of a long side and a short side of the display region 201 by the stencil (rectangle). As described above, when the display region 201 by the stencil is set to the rectangle, the lengths in the real space of the long side and the short side of the rectangle are previously stored in the article management device 1200. The position derivation unit 1206 derives, based on the quadrangular pyramid 2001 specified as above, a three-dimensional positional relationship

image. The second captured image includes the first captured image and the plate (to be the management target of position). The article management device 1200 derives, based on the acquired second captured image and the position of the second image capturing device, the position in the height direction (z-axis direction) of the display region 201 by the stencil. Subsequently, the article management device 1200 derives, based on the position in the height direction (z-axis direction) of the display region 201 by the stencil, the first captured image, and the position of the first image capturing device that captured the first captured image, the three-dimensional position of the display region 201 by the stencil, as the three-dimensional position of the plate. Therefore, even in a case where the position in the height direction of the plate cannot be derived even if the first captured image and the sensor provided to the first capturing device are used, it is possible to manage the position of the plate.

[0164] Further, in the present embodiment, it is set that the display by the stencil and the display by the label are the pieces of information capable of being identified by a person. Therefore, it becomes easy to perform management of actual articles by an operator (worker). Consequently, the convenience in the management of actual articles is improved.

[0165] Further, in the present embodiment, it is set that each of the display by the stencil and the

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[0169] In Fig. 21, a length of a line segment PT is set to h_p . Further, a length of a line segment PF is set to h_1 , $\angle FPT$ is set to θ_1 (rad), a length of a line segment PE is set to h_2 , $\angle EPT$ is set to θ_2 (rad), and $\angle EPF$ is set to θ (rad) ($\theta = \theta_1 + \theta_2$). Further, a length of a line segment FT is set to w_{01} , and a length of a line segment ET is set to w_{02} .

[0170] Accordingly, an x-coordinate x_e of the point E has a value as a result of adding a length l_p of a line segment OT to an x-coordinate x_p of the point P ($x_e = x_p + l_p$). A y-coordinate y_e of the point E has a value as a result of subtracting the length w_{02} of the line segment ET from a y-coordinate y_p of the point P ($y_e = y_p - w_{02}$). Therefore, if the length l_p of the line segment OT and the length w_{02} of the line segment ET are derived, the x-y coordinates (x_e, y_e) at the position of the point E (the origin of the position in article of the stencil) are derived.

[0171] The length l_p of the line segment OT is expressed by the following formula (5).

$$l_p = \sqrt{(h_p^2 - H^2)} = \sqrt{(h_1^2 \cos^2 \theta_1 - H^2)} = \sqrt{(h_2^2 \cos^2 \theta_2 - H^2)} \dots (5)$$

The length w_{02} of the line segment ET is expressed by the following formula (6).

$$w_{02} = h_2 \sin \theta_2 \dots (6)$$

Therefore, if, for example, the length h_2 of the line segment PE and the $\angle EPT$ ($= \theta_2$) are derived, the length l_p of the line segment OT and the length w_{02} of

the luminance image. For example, the position derivation unit 1206 previously stores an image of the stencil (label), as a template image. The position derivation unit 1206 performs pattern matching between the luminance image and the template image, to thereby specify the display region by the stencil (label) from the luminance image. The position derivation unit 1206 specifies a region of the distance image corresponding to the display region by the stencil (label) specified from the luminance image. The position derivation unit 1206 extracts a pixel value of the region specified from the distance image. The pixel value of the distance image is a value indicating a distance from the first image capturing device to the subject. The pixel value extracted from the distance image as described above indicates a distance from the first image capturing device to the display region by the stencil (label). In a manner as described above, the position derivation unit 1206 can obtain the distance from the first image capturing device to the predetermined position of the display region by the stencil (label), based on the pixel value extracted from the distance image. The position derivation unit 1206 derives a three-dimensional position (x-y-z coordinates) of the predetermined position of the display region by the stencil (label), based on a three-dimensional position (x-y-z coordinates) of the first image capturing device, a posture of the first

of the pipes 2301a to 2301c, in order to simplify the notation. However, also on surfaces of the pipes 2301b and 2301c, information including information (IDs) for uniquely identifying the pipes 2301b and 2301c may also be displayed. Further, Fig. 23 exemplifies a case where the pipes 2301a to 2301c are joined by using joint members 2303a and 2303b. However, the joining method of the pipes 2301a to 2301c is not limited to the method using the joint members 2303a and 2303b.

[0197] In the example illustrated in Fig. 23, in a period from when the pipe 2301a is installed to when a hole 2304 is filled up, which makes the pipes 2301a to 2301c disappear from sight, a captured image of a region of the pipe 2301a including the ID 2302 is captured by using a first image capturing device. As above, after the installation, the ID 2302 (information for uniquely identifying an article) is hidden and thus disappears from sight. The role of the first captured image is the same as that of the first captured image described in the first embodiment. As the first image capturing device, a first image capturing device held by an operator (worker), for example, is used. Further, as the first image capturing device, it is also possible to use a first image capturing device provided to an unmanned aircraft (drone). Note that in the description below, the region of the pipe 2301a including the ID 2302 will be referred to