METHOD AND SYSTEM OF IDENTIFYING CONTAINER NUMBER

BACKGROUND OF THE INVENTION

Field of the Invention

Embodiments of the present disclosure relate to detection of a container, and particularly, to a method of identifying a container number and a system of identifying a container number.

Description of the Related Art

Exiting systems of acquiring and identifying a container number includes a handheld device for manually acquiring an image of the container number and extracting number characters from the image, and a device mounted in a unidirectional passageway for a container truck and automatically acquiring an image of the container number and extracting number characters from the image.

For the device mounted in the unidirectional passageway for the container truck and automatically acquiring the image of the container number and extracting number characters from the image, if the container number is soiled or broken or is blocked or is incomplete, it is often difficult to obtain the correct container number only by performing an operation of automatically acquiring the image of the container number one time (i.e., one capturing operation) on one surface of the container.

SUMMARY

The present invention has been made to improve accuracy of identifying the container number and to avoid or reduce the problem of being difficult to read the container number due to the container number on the surface corresponding to an image acquiring unit being

Fig. 22 is a schematic top view of an arrangement of a container number acquisition system according to an eleventh exemplary embodiment of the present disclosure;

Fig. 23 is a process schematic diagram showing capturing statuses of the container number acquisition system shown in Fig. 22, where the upper portion of Fig. 23 illustrates a relative movement between the container and the container number acquisition system and capturing time of the container number acquisition system, and the lower portion of Fig. 23 illustrates a schematic diagram of a capturing time and status transformation relation of the container number acquisition system shown in Fig. 22; and

Fig. 24 is another process schematic diagram showing capturing statuses of the container number acquisition system shown in Fig. 22, where the upper portion of Fig. 24 illustrates a relative movement between the container and the container number acquisition system and capturing time of the container number acquisition system, and the lower portion of Fig. 24 illustrates a schematic diagram of a capturing time and status transformation relation of the container number acquisition system shown in Fig. 22.

DETAINED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Although the present disclosure will be sufficiently described with reference to the attached drawings containing preferred embodiments of the present disclosure, it would be appreciated by those skilled in the art that various changes or modifications may be made in these embodiments without departing from the principle and spirit of the invention, while producing the advantageous effects of the present disclosure. It will be understood that the description of exemplary embodiments of the present disclosure made with reference to the attached drawings is intended to illustrate the general inventive concepts of the present disclosure, and should not be interpreted as being limitative to the present disclosure.

Fig. 1 is a flow chart of a method of acquiring a container number according to an

away from the second signal path of the second group of sensors so that the second signal path is restored, as shown in Fig. 13b; and

acquiring the image of the container number on the other of the front surface and the rear surface of the container by the other corresponding one of the first image acquiring unit and second image acquiring unit (by the second image acquiring unit 12 in Fig. 13), when the other of the front surface and the rear surface departs away from a first signal path of the first group of sensors 11 so that the first signal path is restored, as shown in Fig. 13c.

Fig. 14 is a schematic top view of an arrangement of a container number acquisition system according to a seventh exemplary embodiment of the present disclosure; and Figs. 15a-c are process schematic diagrams of acquiring images of the container numbers on a plurality of surfaces of a container by using the container number acquisition system shown in Fig. 14.

In this embodiment, the trigger unit comprises a second group of sensors and a third group of sensors arranged to space apart from each other in the movement direction of the container relative to the passageway, the second group of sensors includes a second signal transmitter portion 22a and a second signal receiving portion 22b located on either side of the container in the direction perpendicular to the movement direction, and the third group of sensors includes a third signal transmitter portion 23a and a third signal receiving portion 23b located on either side of the container in the direction perpendicular to the movement direction; the trigger unit further comprises a first group of sensors, and the first group of sensors includes a first signal transmitter portion 21a and a first signal receiving portion 21b located on either side of the container in the direction perpendicular to the movement direction, and is located between the second group of sensors and the third group of sensors in the movement direction;

the at least two image acquiring units comprises the first image acquiring unit 11 and the second image acquiring unit 12 adapted to respectively acquire images of the container

numbers on the front surface A1 and the rear surface A2 of the container A, and the at least two image acquiring units further comprises a fourth image acquiring unit 14 adapted to acquire an image of a container number on one side surface of the container;

the step of "acquiring the images of the container numbers on the at least two surfaces of the plurality of surfaces respectively by the at least two image acquiring units at different times based on the signal from the trigger unit" comprises:

when a third signal path of the third group of sensors begins to be blocked by one of the front surface A1 and the rear surface A2 of the container A (by the front surface A1 in Fig. 15), as shown in Fig. 15a, acquiring the image of the container number on the one of the front surface and the rear surface by a corresponding one of the first image acquiring unit and second image acquiring unit (by the first image acquiring unit 11 in Fig. 13);

acquiring the image of the container number on the one side surface (the left side surface A4 in Fig. 13) by the fourth image acquiring unit 14 when the other (the rear surface A2 in Fig. 13) of the front surface and the rear surface of the container begins to depart away from the second signal path of the second group of sensors so that the second signal path is restored, as shown in Fig. 15b; and

acquiring the image of the container number on the other of the front surface and the rear surface of the container by the other corresponding one of the first image acquiring unit and second image acquiring unit (by the second image acquiring unit 12 in Fig. 13), when the other of the front surface and the rear surface departs away from a first signal path of the first group of sensors so that the first signal path is restored, as shown in Fig. 15c.

Fig. 16a is process schematic diagram of acquiring images of the container numbers on a plurality of surfaces of a container according to an eighth exemplary embodiment of the present disclosure; and Fig. 16b is process schematic diagram of acquiring images of the container numbers on a plurality of surfaces of a container according to a variation of the eighth exemplary embodiment of the present disclosure.

As shown in Figs. 16a and 16b, the at least two image acquiring units comprise one image acquiring unit adapted to acquire an image of a container number on one of a front surface, a rear surface, side surfaces, and a top surface of a container (in Fig. 16a, for example, an image acquiring unit 11 which acquires an image of a container number on the front surface A1; in Fig. 16b, for example, an image acquiring unit 12 which acquires an image of a container number on the rear surface A2), and another image acquiring unit adapted to acquire an image of a container number on another one of the front surface, the rear surface, the side surfaces, and the top surface of the container (in Fig. 16a, for example, an image acquiring unit 13 which acquires an image of a container number on the right side surface A3; in Fig. 16b, for example, an image acquiring unit 14 which acquires an image of a container number on the left side surface A4);

the trigger unit comprises a group of sensors, for example, as indicated by reference numerals 21a, 21b in Fig. 16a, 16b, and the one image acquiring unit and the another image acquiring unit are triggered at the same time based on signals from the group of sensors. For example, in Fig. 16a, the image acquiring units 11 and 13 are triggered at the same time based on a signal path of the group of sensors being blocked by the front surface A1 of the container, and in Fig. 16b, the image acquiring units 12 and 14 are triggered at the same time based on restoration of the signal path of the group of sensors after the rear surface A2 of the container departs away.

Fig. 17 is a schematic top view of an arrangement and structure of a container number acquisition system according to a ninth exemplary embodiment of the present disclosure; and Figs. 18a and 18b are process schematic diagrams of acquiring images of the container numbers on a plurality of surfaces of a container by using the container number acquisition system shown in Fig. 16.

As shown in Fig. 17 and Fig. 18a and 18b, the at least two image acquiring units comprise one image acquiring unit adapted to acquire an image of a container number on

one of a front surface, a rear surface, side surfaces, and a top surface of a container (in Fig. 18a, for example, an image acquiring unit 11 which acquires an image of a container number on the front surface A1), and another image acquiring unit adapted to acquire an image of a container number on another one of the front surface, the rear surface, the side surfaces, and the top surface of the container (in Fig. 18b, for example, an image acquiring unit 13 which acquires an image of a container number on the left side surface A3); the trigger unit comprises two groups of sensors 22, 23, and the one image acquiring unit 11 and the another image acquiring unit 13 are triggered at the same time based on signals from the two groups of sensors; each group of sensors includes a signal transmitter portion and a signal receiving portion located on either side of the container in a direction perpendicular to the movement direction of the container relative to the passageway.

Fig. 19 is a schematic top view of an arrangement and structure of a container number acquisition system according to a tenth exemplary embodiment of the present disclosure, showing symmetrical arrangements of image acquiring units and sensors. Fig. 20 is a process schematic diagram showing capturing statuses of the container number acquisition system shown in Fig. 19, where the upper portion of Fig. 20 illustrates a relative movement between the container and the container number acquisition system and capturing time of the container number acquisition system, and the lower portion of Fig. 20 illustrates a schematic diagram of a capturing time and status transformation relation of the container number acquisition system shown in Fig. 19.

In Fig. 19, the system comprise three groups of sensors, for example, photosensors, which respectively has or defines signal paths L1, L2, L3, and four image acquiring units 11, 12, 13, 14, for example, video cameras; wherein a sensor status is set as S3S2S1, where S3, S2 and S1 correspond to L2, L1 and L3 respectively, an image acquiring unit operation status is set as C4C3C2C1, where C4, C3, C2 and C1 correspond to the image acquiring units 12, 14, 13 and 11 respectively; it is assumed that S=1 indicates that the signal path of

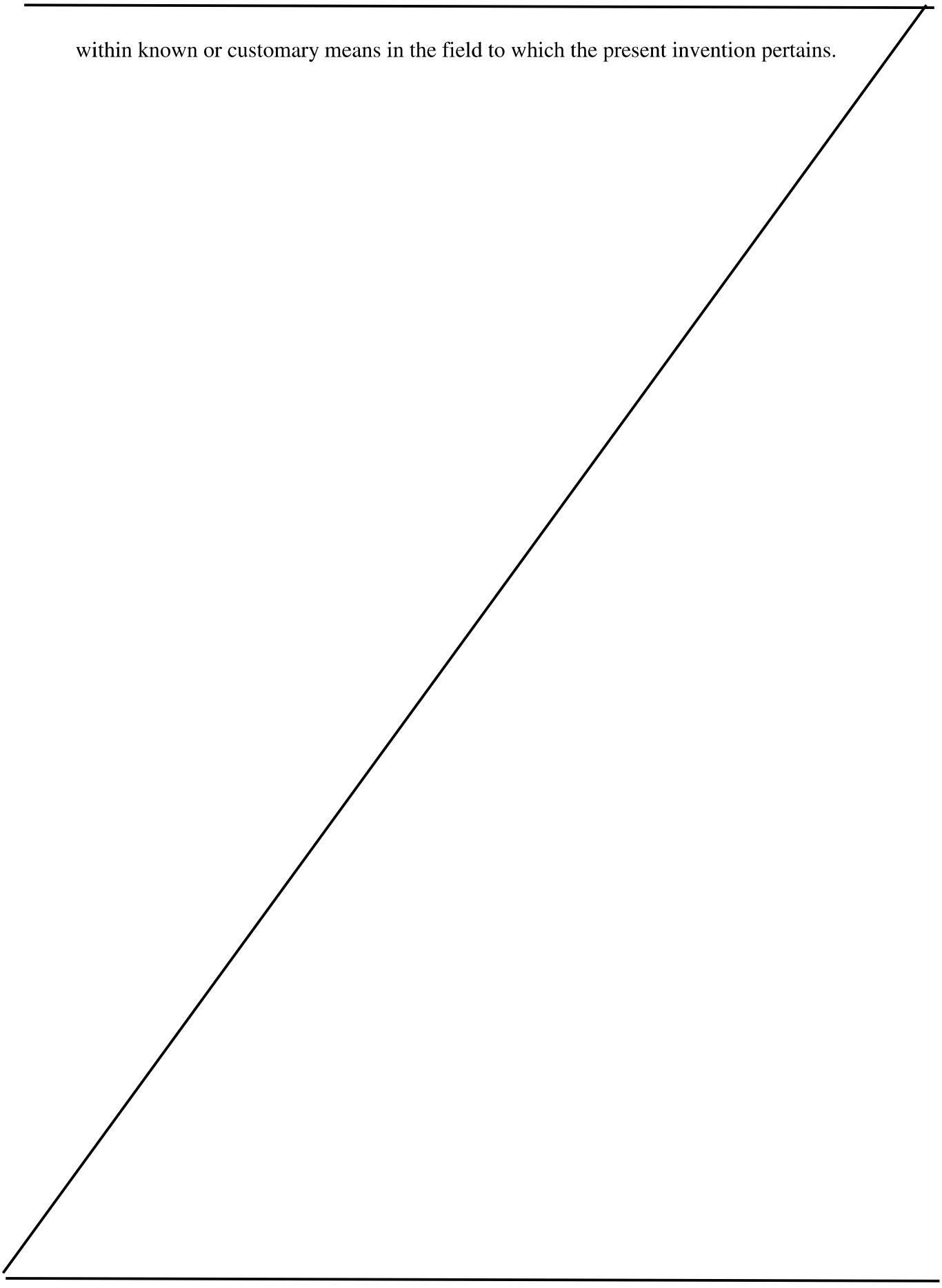
image acquiring unit, and there may be not enough time to finish the automatic focusing operation when the container passes at a high speed, thereby resulting in out of focus of the image.

As shown in Fig. 17, the at least two image acquiring units comprise one image acquiring unit 11 (12) adapted to acquire an image of a container number on one of a front surface, a rear surface, side surfaces, and a top surface of a container, and another image acquiring unit 13 (14) adapted to acquire an image of a container number on another one of the front surface, the rear surface, the side surfaces, and the top surface of the container; the trigger unit comprises a group of sensors, and the one image acquiring unit and the another image acquiring unit may be triggered at the same time based on signals from the group of sensors.

As shown in Figs. 18-19, the at least two image acquiring units comprise one image acquiring unit 11 adapted to acquire an image of a container number on one of a front surface, a rear surface, side surfaces, and a top surface of a container, and another image acquiring unit 13 adapted to acquire an image of a container number on another one of the front surface, the rear surface, the side surfaces, and the top surface of the container; the trigger unit comprises two groups of sensors 22, 23, and the one image acquiring unit and the another image acquiring unit may be triggered at the same time based on signals from the two groups of sensors; each group of sensors includes a signal transmitter portion and a signal receiving portion located on either side of the container in a direction perpendicular to the movement direction of the container relative to the passageway.

Although several exemplary embodiments incorporating principles of the present invention have been shown and described above, the present invention is not limited to the disclosed embodiments. Rather, the present applicant is intended to cover any changes, uses or modifications by using general principles of the present invention. Further, the present invention is intended to cover contents departing from the present disclosure and falling

within known or customary means in the field to which the present invention pertains.



What is claimed is:

1. A method of identifying a container number, comprising steps of:

arranging an image acquiring device along a passageway through which a container passes, the image acquiring device comprising a trigger unit and a plurality of image acquiring units, at least two image acquiring units of the plurality of image acquiring units being adapted to respectively acquire images of container numbers on at least two surfaces of a plurality of surfaces of the container passing through the passageway;

acquiring the images of the container numbers on the at least two surfaces respectively by the at least two image acquiring units based on a signal from the trigger unit; and

identifying the container number at least based on the images or data from the at least two image acquiring units about the container number.

2. The method according to claim 1, comprising:

acquiring the images of the container numbers on the at least two surfaces of the plurality of surfaces respectively by the at least two image acquiring units of the plurality of image acquiring units at different times based on the signal from the trigger unit ,

wherein a distance between projections of the at least two image acquiring units in a movement direction of the container relative to the passageway is less than the length of the container.

3. The method according to claim 2, wherein:

the at least two image acquiring units are positioned such that a relative position of each of the at least two image acquiring units with respect to a corresponding one of the surfaces of the container is fixed in two opposite movement directions of the container relative to the passageway when acquiring the image of the container number on the corresponding surface.

4. The method according to claim 2 or 3, wherein:

the trigger unit comprises a first group of sensors including a first signal receiving portion configured to sense a position of the container relative to the passageway;

the at least two image acquiring units comprise a first image acquiring unit and a second image acquiring unit adapted to respectively acquire images of the container numbers on a front surface and a rear surface of the container;

the step of "acquiring the images of the container numbers on the at least two surfaces of the plurality of surfaces respectively by the at least two image acquiring units of the plurality of image acquiring units at different times based on the signal from the trigger unit" comprises:

acquiring the image of the container number on one of the front surface and the rear surface of the container by a corresponding one of the first image acquiring unit and second image acquiring unit, when a first signal path of the first group of sensors begins to be blocked by the one of the front surface and the rear surface; and

acquiring the image of the container number on the other of the front surface and the rear surface of the container by the other one of the first image acquiring unit and second image acquiring unit, when the other of the front surface and the rear surface of the container departs away from the first signal path of the first group of sensors so that the first signal path is restored.

5. The method according to claim 4, wherein:

a midpoint of a connection line between the first image acquiring unit and the second image acquiring unit is a midpoint of the first signal path.

6. The method according to claim 2 or 3, wherein:

the trigger unit comprises a second group of sensors and a third group of sensors arranged to space apart from each other in the movement direction, the second group of sensors including a second signal receiving portion configured to sense a position of the container relative to the passageway, the third group of sensors including a third signal

receiving portion configured to sense the position of the container relative to the passageway;

the at least two image acquiring units comprise a first image acquiring unit and a second image acquiring unit adapted to respectively acquire images of the container numbers on a front surface and a rear surface of the container;

the step of "acquiring the images of the container numbers on the at least two surfaces of the plurality of surfaces respectively by the at least two image acquiring units of the plurality of image acquiring units at different times based on the signal from the trigger unit" comprises:

acquiring the image of the container number on one of the front surface and the rear surface of the container by a corresponding one of the first image acquiring unit and second image acquiring unit, when a second signal path of the second group of sensors begins to be blocked by the one of the front surface and the rear surface; and

acquiring the image of the container number on the other of the front surface and the rear surface of the container by the other one of the first image acquiring unit and second image acquiring unit, when the other of the front surface and the rear surface departs away from a third signal path of the third group of sensors so that the third signal path is restored.

7. The method according to claim 6, wherein:

the at least two image acquiring units further comprises a third image acquiring unit adapted to acquire an image of a container number on one side surface of the container;

the step of "acquiring the images of the container numbers on the at least two surfaces of the plurality of surfaces respectively by the at least two image acquiring units of the plurality of image acquiring units at different times based on the signal from the trigger unit" further comprises:

acquiring the image of the container number on the one side surface by the third image acquiring unit when the third signal path of the third group of sensors begins to be blocked

by the one of the front surface and the rear surface of the container.

8. The method according to claim 7, wherein:

the at least two image acquiring units further comprises a fourth image acquiring unit adapted to acquire an image of a container number on another side surface of the container;

the step of "acquiring the images of the container numbers on the at least two surfaces of the plurality of surfaces respectively by the at least two image acquiring units of the plurality of image acquiring units at different times based on the signal from the trigger unit" further comprises:

acquiring the image of the container number on the another side surface by the fourth image acquiring unit when the one of the front surface and the rear surface of the container departs away from the second signal path of the second group of sensors so that the second signal path is restored.

9. The method according to claim 8, wherein:

a midpoint of a connection line between the first image acquiring unit and the second image acquiring unit is also a midpoint of a connection line between the third image acquiring unit and the fourth image acquiring unit.

10. The method according to claim 6, wherein:

the trigger unit further comprises a first group of sensors including a first signal receiving portion configured to sense the position of the container relative to the passageway, the first group of sensors being located between the second group of sensors and the third group of sensors in the movement direction;

the at least two image acquiring units further comprises a third image acquiring unit adapted to acquire an image of a container number on one side surface of the container and a fourth image acquiring unit adapted to acquire an image of a container number on another side surface of the container;

the step of "acquiring the images of the container numbers on the at least two surfaces

of the plurality of surfaces respectively by the at least two image acquiring units of the plurality of image acquiring units at different times based on the signal from the trigger unit" further comprises:

acquiring the image of the container number on the one side surface by the third image acquiring unit when a first signal path of the first group of sensors begins to be blocked by one of the front surface and the rear surface of the container; and

acquiring the image of the container number on the another side surface by the fourth image acquiring unit when the other of the front surface and the rear surface of the container departs away from the first signal path so that the first signal path of the first group of sensors is restored.

11. The method according to claim 10, wherein:

the first group of sensors is located at an intermediate position between the second group of sensors and the third group of sensors in the movement direction; and

a midpoint of a connection line between the first image acquiring unit and the second image acquiring unit is also a midpoint of a connection line between the third image acquiring unit and the fourth image acquiring unit and a midpoint of the first signal path.

12. The method according to claim 2, wherein:

the trigger unit comprises a second group of sensors and a third group of sensors arranged to space apart from each other in the movement direction, the second group of sensors including a second signal receiving portion configured to sense a position of the container relative to the passageway, the third group of sensors including a third signal receiving portion configured to sense the position of the container relative to the passageway;

the at least two image acquiring units comprise a first image acquiring unit and a second image acquiring unit adapted to respectively acquire images of the container numbers on a front surface and a rear surface of the container;

the at least two image acquiring units further comprises a third image acquiring unit adapted to acquire an image of a container number on one side surface of the container and a fourth image acquiring unit adapted to acquire an image of a container number on another side surface of the container;

the step of "acquiring the images of the container numbers on the at least two surfaces of the plurality of surfaces respectively by the at least two image acquiring units of the plurality of image acquiring units at different times based on the signal from the trigger unit" comprises:

acquiring the image of the container number on the one side surface by the third image acquiring unit and acquiring the image of the container number on one of the front surface and the rear surface of the container by a corresponding one of the first image acquiring unit and second image acquiring unit, when a third signal path of the third group of sensors begins to be blocked by the one of the front surface and the rear surface; and

acquiring the image of the container number on the another side surface by the fourth image acquiring unit and acquiring the image of the container number on the other of the front surface and the rear surface of the container by the other one of the first image acquiring unit and second image acquiring unit, when the other of the front surface and the rear surface departs away from a second signal path of the second group of sensors so that the second signal path is restored.

13. The method according to claim 2, wherein:

the trigger unit comprises a second group of sensors and a third group of sensors arranged to space apart from each other in the movement direction, the second group of sensors including a second signal receiving portion configured to sense a position of the container relative to the passageway, the third group of sensors including a third signal receiving portion configured to sense the position of the container relative to the passageway;

the at least two image acquiring units comprise a first image acquiring unit and a second image acquiring unit adapted to respectively acquire images of the container numbers on a front surface and a rear surface of the container;

the trigger unit further comprises a first group of sensors including a first signal receiving portion configured to sense the position of the container relative to the passageway, the first group of sensors being located between the second group of sensors and the third group of sensors in the movement direction;

the at least two image acquiring units further comprises a third image acquiring unit adapted to acquire an image of a container number on one side surface of the container and a fourth image acquiring unit adapted to acquire an image of a container number on another side surface of the container;

the step of "acquiring the images of the container numbers on the at least two surfaces of the plurality of surfaces respectively by the at least two image acquiring units of the plurality of image acquiring units at different times based on the signal from the trigger unit" comprises:

acquiring the image of the container number on the one side surface by the third image acquiring unit and acquiring the image of the container number on one of the front surface and the rear surface of the container by a corresponding one of the first image acquiring unit and second image acquiring unit, when a third signal path of the third group of sensors begins to be blocked by the one of the front surface and the rear surface;

acquiring the image of the container number on the another side surface by the fourth image acquiring unit, when the other of the front surface and the rear surface of the container departs away from a second signal path of the second group of sensors so that the second signal path is restored; and

acquiring the image of the container number on the other of the front surface and the rear surface of the container by the other corresponding one of the first image acquiring unit

and second image acquiring unit, when the other of the front surface and the rear surface departs away from a first signal path of the first group of sensors so that the first signal path is restored.

14. The method according to any one of claims 1 to 13, wherein the step of arranging an image acquiring device comprises providing a carrying vehicle, which defines the passageway and on which the image acquiring device is arranged.

15. The method according to any one of claims 1 to 14, wherein the trigger unit is configured to generate the signal based on a relative movement between the container and the passageway.

16. A system of identifying a container number, comprising:

an image acquiring device arranged along a passageway through which a container passes, the image acquiring device comprising a trigger unit and a plurality of image acquiring units, at least two image acquiring units of the plurality of image acquiring units being adapted to respectively acquire images of container numbers on at least two surfaces of a plurality of surfaces of the container passing through the passageway; and

a number identification device configured to identify the container number at least based on the images or data from the at least two image acquiring units about the container number, wherein

a distance between projections of the at least two image acquiring units in a movement direction of the container relative to the passageway is less than the length of the container.

17. The system according to claim 16, wherein

the length of the container is a length of a standard short container.

18. The system according to claim 16, wherein:

a relative position of each of the at least two image acquiring units with respect to a corresponding one of the surfaces of the container is fixed in two opposite movement directions when acquiring the image of the container number on the corresponding surface.

19. The system according to any one of claims 16 to 18, wherein:

the trigger unit comprises a first group of sensors including a first signal receiving portion configured to sense a position of the container relative to the passageway;

the at least two image acquiring units comprise a first image acquiring unit and a second image acquiring unit adapted to respectively acquire images of the container numbers on a front surface and a rear surface of the container, the first image acquiring unit and the second image acquiring unit being located on either side of a first signal path of the first group of sensors respectively.

20. The system according to claim 19, wherein:

a midpoint of a connection line between the first image acquiring unit and the second image acquiring unit is a midpoint of the first signal path.

21. The system according to any one of claims 16 to 18, wherein:

the trigger unit comprises a second group of sensors and a third group of sensors arranged to space apart from each other in the movement direction, the second group of sensors including a second signal receiving portion configured to sense a position of the container relative to the passageway, the third group of sensors including a third signal receiving portion configured to sense the position of the container relative to the passageway;

the at least two image acquiring units comprise a first image acquiring unit and a second image acquiring unit adapted to respectively acquire images of the container numbers on a front surface and a rear surface of the container, the first image acquiring unit and the second image acquiring unit being located on either side of a first signal path of the first group of sensors respectively.

22. The system according to claim 21, wherein:

the at least two image acquiring units further comprises a third image acquiring unit adapted to acquire an image of a container number on one side surface of the container.

23. The system according to claim 22, wherein:

the at least two image acquiring units further comprises a fourth image acquiring unit adapted to acquire an image of a container number on another side surface of the container.

24. The system according to claim 23, wherein:

a midpoint of a connection line between the first image acquiring unit and the second image acquiring unit is also a midpoint of a connection line between the third image acquiring unit and the fourth image acquiring unit.

25. The system according to claim 21, wherein:

the trigger unit further comprises a first group of sensors including a first signal receiving portion configured to sense the position of the container relative to the passageway, the first group of sensors being located between the second group of sensors and the third group of sensors in the movement direction of the container;

the at least two image acquiring units further comprises a third image acquiring unit adapted to acquire an image of a container number on one side surface of the container and a fourth image acquiring unit adapted to acquire an image of a container number on another side surface of the container.

26. The system according to claim 25, wherein:

the first group of sensors is located at an intermediate position between the second group of sensors and the third group of sensors in the movement direction; and

a midpoint of a connection line between the first image acquiring unit and the second image acquiring unit is also a midpoint of the first signal path and a midpoint of a connection line between the third image acquiring unit and the fourth image acquiring unit.

27. The system according to any one of claims 16-26, wherein the system further comprises a carrying vehicle, which defines the passageway and on which the image acquiring device is arranged.

28. The system according to any one of claims 16 to 27, wherein the trigger unit is

configured to generate a signal based on a relative movement between the container and the passageway.

METHOD AND SYSTEM OF IDENTIFYING CONTAINER NUMBER

BACKGROUND

Field

Embodiments of the present disclosure relate to detection of a container, and particularly, to a method of identifying a container number and a system of identifying a container number.

Description of the Related Art

Exiting systems of acquiring and identifying a container number includes a handheld device for manually acquiring an image of the container number and extracting number characters from the image, and a device mounted in a unidirectional passageway for a container truck and automatically acquiring an image of the container number and extracting number characters from the image.

For the device mounted in the unidirectional passageway for the container truck and automatically acquiring the image of the container number and extracting number characters from the image, if the container number is soiled or broken or is blocked or is incomplete, it is often difficult to obtain the correct container number only by performing an operation of automatically acquiring the image of the container number one time (i.e., one capturing operation) on one surface of the container.

SUMMARY

The invention is defined in the independent claims. Some optional features of the invention are defined in the dependent claims.

The present disclosure has been made to improve accuracy of identifying the container number and to avoid or reduce the problem of being difficult to read the container number due to the container number on the surface corresponding to an image acquiring unit being

Fig. 22 is a schematic top view of an arrangement of a container number acquisition system according to an eleventh exemplary embodiment of the present disclosure;

Fig. 23 is a process schematic diagram showing capturing statuses of the container number acquisition system shown in Fig. 22, where the upper portion of Fig. 23 illustrates a relative movement between the container and the container number acquisition system and capturing time of the container number acquisition system, and the lower portion of Fig. 23 illustrates a schematic diagram of a capturing time and status transformation relation of the container number acquisition system shown in Fig. 22; and

Fig. 24 is another process schematic diagram showing capturing statuses of the container number acquisition system shown in Fig. 22, where the upper portion of Fig. 24 illustrates a relative movement between the container and the container number acquisition system and capturing time of the container number acquisition system, and the lower portion of Fig. 24 illustrates a schematic diagram of a capturing time and status transformation relation of the container number acquisition system shown in Fig. 22.

DETAINED DESCRIPTION OF PREFERRED EMBODIMENTS

Although the present disclosure will be sufficiently described with reference to the attached drawings containing preferred embodiments of the present disclosure, it would be appreciated by those skilled in the art that various changes or modifications may be made in these embodiments without departing from the principle and spirit of the disclosure, while producing the advantageous effects of the present disclosure. It will be understood that the description of exemplary embodiments of the present disclosure made with reference to the attached drawings is intended to illustrate the general inventive concepts of the present disclosure, and should not be interpreted as being limitative to the present disclosure.

Fig. 1 is a flow chart of a method of acquiring a container number according to an

away from the second signal path of the second group of sensors so that the second signal path is restored, as shown in Fig. 13b; and

acquiring the image of the container number on the other of the front surface and the rear surface of the container by the other corresponding one of the first image acquiring unit and second image acquiring unit (by the second image acquiring unit 12 in Fig. 13), when the other of the front surface and the rear surface departs away from a first signal path of the first group of sensors so that the first signal path is restored, as shown in Fig. 13c.

Fig. 14 is a schematic top view of an arrangement of a container number acquisition system according to a seventh exemplary embodiment of the present disclosure; and Figs. 15a-c are process schematic diagrams of acquiring images of the container numbers on a plurality of surfaces of a container by using the container number acquisition system shown in Fig. 14.

In this embodiment, the trigger unit comprises a second group of sensors and a third group of sensors arranged to space apart from each other in the movement direction of the container relative to the passageway, the second group of sensors includes a second signal transmitter portion 22a and a second signal receiving portion 22b located on either side of the container in the direction perpendicular to the movement direction, and the third group of sensors includes a third signal transmitter portion 23a and a third signal receiving portion 23b located on either side of the container in the direction perpendicular to the movement direction; the trigger unit further comprises a first group of sensors, and the first group of sensors includes a first signal transmitter portion 21a and a first signal receiving portion 21b located on either side of the container in the direction perpendicular to the movement direction, and is located between the second group of sensors and the third group of sensors in the movement direction;

the at least two image acquiring units comprises the first image acquiring unit 11 and the second image acquiring unit 12 adapted to respectively acquire images of the container

numbers on the front surface A1 and the rear surface A2 of the container A, and the at least two image acquiring units further comprises a fourth image acquiring unit 14 adapted to acquire an image of a container number on one side surface of the container;

the step of "acquiring the images of the container numbers on the at least two surfaces of the plurality of surfaces respectively by the at least two image acquiring units at different times based on the signal from the trigger unit" comprises:

when a third signal path of the third group of sensors begins to be blocked by one of the front surface A1 and the rear surface A2 of the container A (by the front surface A1 in Fig. 15), as shown in Fig. 15a, acquiring the image of the container number on the one of the front surface and the rear surface by a corresponding one of the first image acquiring unit and second image acquiring unit (by the first image acquiring unit 11 in Fig. 15);

acquiring the image of the container number on the one side surface (the left side surface A4 in Fig. 15) by the fourth image acquiring unit 14 when the other (the rear surface A2 in Fig. 15) of the front surface and the rear surface of the container begins to depart away from the second signal path of the second group of sensors so that the second signal path is restored, as shown in Fig. 15b; and

acquiring the image of the container number on the other of the front surface and the rear surface of the container by the other corresponding one of the first image acquiring unit and second image acquiring unit (by the second image acquiring unit 12 in Fig. 15), when the other of the front surface and the rear surface departs away from a first signal path of the first group of sensors so that the first signal path is restored, as shown in Fig. 15c.

Fig. 16a is process schematic diagram of acquiring images of the container numbers on a plurality of surfaces of a container according to an eighth exemplary embodiment of the present disclosure; and Fig. 16b is process schematic diagram of acquiring images of the container numbers on a plurality of surfaces of a container according to a variation of the eighth exemplary embodiment of the present disclosure.

As shown in Figs. 16a and 16b, the at least two image acquiring units comprise one image acquiring unit adapted to acquire an image of a container number on one of a front surface, a rear surface, side surfaces, and a top surface of a container (in Fig. 16a, for example, an image acquiring unit 11 which acquires an image of a container number on the front surface A1; in Fig. 16b, for example, an image acquiring unit 12 which acquires an image of a container number on the rear surface A2), and another image acquiring unit adapted to acquire an image of a container number on another one of the front surface, the rear surface, the side surfaces, and the top surface of the container (in Fig. 16a, for example, an image acquiring unit 13 which acquires an image of a container number on the right side surface A3; in Fig. 16b, for example, an image acquiring unit 14 which acquires an image of a container number on the left side surface A4);

the trigger unit comprises a group of sensors, for example, as indicated by reference numerals 21a, 21b in Fig. 16a, 16b, and the one image acquiring unit and the another image acquiring unit are triggered at the same time based on signals from the group of sensors. For example, in Fig. 16a, the image acquiring units 11 and 13 are triggered at the same time based on a signal path of the group of sensors being blocked by the front surface A1 of the container, and in Fig. 16b, the image acquiring units 12 and 14 are triggered at the same time based on restoration of the signal path of the group of sensors after the rear surface A2 of the container departs away.

Fig. 17 is a schematic top view of an arrangement and structure of a container number acquisition system according to a ninth exemplary embodiment of the present disclosure; and Figs. 18a and 18b are process schematic diagrams of acquiring images of the container numbers on a plurality of surfaces of a container by using the container number acquisition system shown in Fig. 17.

As shown in Fig. 17 and Fig. 18a and 18b, the at least two image acquiring units comprise one image acquiring unit adapted to acquire an image of a container number on

one of a front surface, a rear surface, side surfaces, and a top surface of a container (in Fig. 18a, for example, an image acquiring unit 11 which acquires an image of a container number on the front surface A1), and another image acquiring unit adapted to acquire an image of a container number on another one of the front surface, the rear surface, the side surfaces, and the top surface of the container (in Fig. 18b, for example, an image acquiring unit 13 which acquires an image of a container number on the right side surface A3); the trigger unit comprises two groups of sensors 22, 23, and the one image acquiring unit 11 and the another image acquiring unit 13 are triggered at the same time based on signals from the two groups of sensors; each group of sensors includes a signal transmitter portion and a signal receiving portion located on either side of the container in a direction perpendicular to the movement direction of the container relative to the passageway.

Fig. 19 is a schematic top view of an arrangement and structure of a container number acquisition system according to a tenth exemplary embodiment of the present disclosure, showing symmetrical arrangements of image acquiring units and sensors. Fig. 20 is a process schematic diagram showing capturing statuses of the container number acquisition system shown in Fig. 19, where the upper portion of Fig. 20 illustrates a relative movement between the container and the container number acquisition system and capturing time of the container number acquisition system, and the lower portion of Fig. 20 illustrates a schematic diagram of a capturing time and status transformation relation of the container number acquisition system shown in Fig. 19.

In Fig. 19, the system comprise three groups of sensors, for example, photosensors, which respectively has or defines signal paths L1, L2, L3, and four image acquiring units 11, 12, 13, 14, for example, video cameras; wherein a sensor status is set as S3S2S1, where S3, S2 and S1 correspond to L2, L1 and L3 respectively, an image acquiring unit operation status is set as C4C3C2C1, where C4, C3, C2 and C1 correspond to the image acquiring units 12, 14, 13 and 11 respectively; it is assumed that S=1 indicates that the signal path of

image acquiring unit, and there may be not enough time to finish the automatic focusing operation when the container passes at a high speed, thereby resulting in out of focus of the image.

As shown in Fig. 17, the at least two image acquiring units comprise one image acquiring unit 11 (12) adapted to acquire an image of a container number on one of a front surface, a rear surface, side surfaces, and a top surface of a container, and another image acquiring unit 13 (14) adapted to acquire an image of a container number on another one of the front surface, the rear surface, the side surfaces, and the top surface of the container; the trigger unit comprises a group of sensors, and the one image acquiring unit and the another image acquiring unit may be triggered at the same time based on signals from the group of sensors.

As shown in Figs. 18-19, the at least two image acquiring units comprise one image acquiring unit 11 adapted to acquire an image of a container number on one of a front surface, a rear surface, side surfaces, and a top surface of a container, and another image acquiring unit 13 adapted to acquire an image of a container number on another one of the front surface, the rear surface, the side surfaces, and the top surface of the container; the trigger unit comprises two groups of sensors 22, 23, and the one image acquiring unit and the another image acquiring unit may be triggered at the same time based on signals from the two groups of sensors; each group of sensors includes a signal transmitter portion and a signal receiving portion located on either side of the container in a direction perpendicular to the movement direction of the container relative to the passageway.

Although several exemplary embodiments incorporating principles of the present invention have been shown and described above, the present invention is not limited to the disclosed embodiments. Rather, the present application is intended to cover any changes, uses or modifications by using general principles of the present invention. Further, the present invention is intended to cover contents departing from the present disclosure and

falling within known or customary means in the field to which the present invention pertains.

What is claimed is:

1. A method of identifying a container number, comprising steps of:

arranging an image acquiring device along a passageway through which a container passes, the image acquiring device comprising a trigger unit and a plurality of image acquiring units, at least two image acquiring units of the plurality of image acquiring units being adapted to respectively acquire images of container numbers on at least two surfaces of a plurality of surfaces of the container passing through the passageway;

acquiring the images of the container numbers on the at least two surfaces respectively by the at least two image acquiring units based on a signal from the trigger unit; and

identifying the container number at least based on the images or data from the at least two image acquiring units about the container number.

2. The method according to claim 1, comprising:

acquiring the images of the container numbers on the at least two surfaces of the plurality of surfaces respectively by the at least two image acquiring units of the plurality of image acquiring units at different times based on the signal from the trigger unit ,

wherein a distance between projections of the at least two image acquiring units in a movement direction of the container relative to the passageway is less than the length of the container.

3. The method according to claim 2, wherein:

the trigger unit comprises a first group of sensors including a first signal receiving portion configured to sense a position of the container relative to the passageway;

the at least two image acquiring units comprise a first image acquiring unit and a second image acquiring unit adapted to respectively acquire images of the container numbers on a front surface and a rear surface of the container;

the step of “acquiring the images of the container numbers on the at least two surfaces

of the plurality of surfaces respectively by the at least two image acquiring units of the plurality of image acquiring units at different times based on the signal from the trigger unit" comprises:

acquiring the image of the container number on one of the front surface and the rear surface of the container by a corresponding one of the first image acquiring unit and second image acquiring unit, when a first signal path of the first group of sensors begins to be blocked by the one of the front surface and the rear surface; and

acquiring the image of the container number on the other of the front surface and the rear surface of the container by the other one of the first image acquiring unit and second image acquiring unit, when the other of the front surface and the rear surface of the container departs away from the first signal path of the first group of sensors so that the first signal path is restored.

4. The method according to claim 2, wherein:

the trigger unit comprises a second group of sensors and a third group of sensors arranged to space apart from each other in the movement direction, the second group of sensors including a second signal receiving portion configured to sense a position of the container relative to the passageway, the third group of sensors including a third signal receiving portion configured to sense the position of the container relative to the passageway;

the at least two image acquiring units comprise a first image acquiring unit and a second image acquiring unit adapted to respectively acquire images of the container numbers on a front surface and a rear surface of the container;

the step of "acquiring the images of the container numbers on the at least two surfaces of the plurality of surfaces respectively by the at least two image acquiring units of the plurality of image acquiring units at different times based on the signal from the trigger unit"

comprises:

acquiring the image of the container number on one of the front surface and the rear surface of the container by a corresponding one of the first image acquiring unit and second image acquiring unit, when a second signal path of the second group of sensors begins to be blocked by the one of the front surface and the rear surface; and

acquiring the image of the container number on the other of the front surface and the rear surface of the container by the other one of the first image acquiring unit and second image acquiring unit, when the other of the front surface and the rear surface departs away from a third signal path of the third group of sensors so that the third signal path is restored.

5. The method according to claim 4, wherein:

the at least two image acquiring units further comprises a third image acquiring unit adapted to acquire an image of a container number on one side surface of the container;

the step of "acquiring the images of the container numbers on the at least two surfaces of the plurality of surfaces respectively by the at least two image acquiring units of the plurality of image acquiring units at different times based on the signal from the trigger unit" further comprises:

acquiring the image of the container number on the one side surface by the third image acquiring unit when the third signal path of the third group of sensors begins to be blocked by the one of the front surface and the rear surface of the container.

6. The method according to claim 5, wherein:

the at least two image acquiring units further comprises a fourth image acquiring unit adapted to acquire an image of a container number on another side surface of the container;

the step of "acquiring the images of the container numbers on the at least two surfaces of the plurality of surfaces respectively by the at least two image acquiring units of the plurality of image acquiring units at different times based on the signal from the trigger unit"

further comprises:

acquiring the image of the container number on the another side surface by the fourth image acquiring unit when the one of the front surface and the rear surface of the container departs away from the second signal path of the second group of sensors so that the second signal path is restored.

7. The method according to claim 4, wherein:

the trigger unit further comprises a first group of sensors including a first signal receiving portion configured to sense the position of the container relative to the passageway, the first group of sensors being located between the second group of sensors and the third group of sensors in the movement direction;

the at least two image acquiring units further comprises a third image acquiring unit adapted to acquire an image of a container number on one side surface of the container and a fourth image acquiring unit adapted to acquire an image of a container number on another side surface of the container;

the step of "acquiring the images of the container numbers on the at least two surfaces of the plurality of surfaces respectively by the at least two image acquiring units of the plurality of image acquiring units at different times based on the signal from the trigger unit" further comprises:

acquiring the image of the container number on the one side surface by the third image acquiring unit when a first signal path of the first group of sensors begins to be blocked by one of the front surface and the rear surface of the container; and

acquiring the image of the container number on the another side surface by the fourth image acquiring unit when the other of the front surface and the rear surface of the container departs away from the first signal path so that the first signal path of the first group of sensors is restored.

8. The method according to claim 2, wherein:

the trigger unit comprises a second group of sensors and a third group of sensors arranged to space apart from each other in the movement direction, the second group of sensors including a second signal receiving portion configured to sense a position of the container relative to the passageway, the third group of sensors including a third signal receiving portion configured to sense the position of the container relative to the passageway;

the at least two image acquiring units comprise a first image acquiring unit and a second image acquiring unit adapted to respectively acquire images of the container numbers on a front surface and a rear surface of the container;

the at least two image acquiring units further comprises a third image acquiring unit adapted to acquire an image of a container number on one side surface of the container and a fourth image acquiring unit adapted to acquire an image of a container number on another side surface of the container;

the step of "acquiring the images of the container numbers on the at least two surfaces of the plurality of surfaces respectively by the at least two image acquiring units of the plurality of image acquiring units at different times based on the signal from the trigger unit" comprises:

acquiring the image of the container number on the one side surface by the third image acquiring unit and acquiring the image of the container number on one of the front surface and the rear surface of the container by a corresponding one of the first image acquiring unit and second image acquiring unit, when a third signal path of the third group of sensors begins to be blocked by the one of the front surface and the rear surface; and

acquiring the image of the container number on the another side surface by the fourth image acquiring unit and acquiring the image of the container number on the other of the

front surface and the rear surface of the container by the other one of the first image acquiring unit and second image acquiring unit, when the other of the front surface and the rear surface departs away from a second signal path of the second group of sensors so that the second signal path is restored.

9. The method according to claim 2, wherein:

the trigger unit comprises a second group of sensors and a third group of sensors arranged to space apart from each other in the movement direction, the second group of sensors including a second signal receiving portion configured to sense a position of the container relative to the passageway, the third group of sensors including a third signal receiving portion configured to sense the position of the container relative to the passageway;

the at least two image acquiring units comprise a first image acquiring unit and a second image acquiring unit adapted to respectively acquire images of the container numbers on a front surface and a rear surface of the container;

the trigger unit further comprises a first group of sensors including a first signal receiving portion configured to sense the position of the container relative to the passageway, the first group of sensors being located between the second group of sensors and the third group of sensors in the movement direction;

the at least two image acquiring units further comprises a third image acquiring unit adapted to acquire an image of a container number on one side surface of the container and a fourth image acquiring unit adapted to acquire an image of a container number on another side surface of the container;

the step of "acquiring the images of the container numbers on the at least two surfaces of the plurality of surfaces respectively by the at least two image acquiring units of the plurality of image acquiring units at different times based on the signal from the trigger unit"

comprises:

acquiring the image of the container number on the one side surface by the third image acquiring unit and acquiring the image of the container number on one of the front surface and the rear surface of the container by a corresponding one of the first image acquiring unit and second image acquiring unit, when a third signal path of the third group of sensors begins to be blocked by the one of the front surface and the rear surface;

acquiring the image of the container number on the another side surface by the fourth image acquiring unit, when the other of the front surface and the rear surface of the container departs away from a second signal path of the second group of sensors so that the second signal path is restored; and

acquiring the image of the container number on the other of the front surface and the rear surface of the container by the other corresponding one of the first image acquiring unit and second image acquiring unit, when the other of the front surface and the rear surface departs away from a first signal path of the first group of sensors so that the first signal path is restored.

10. The method according to any one of claims 1 to 9, wherein the step of arranging an image acquiring device comprises providing a carrying vehicle, which defines the passageway and on which the image acquiring device is arranged; and/or the trigger unit is configured to generate the signal based on a relative movement between the container and the passageway.

11. A system of identifying a container number, comprising:

an image acquiring device arranged along a passageway through which a container passes, the image acquiring device comprising a trigger unit and a plurality of image acquiring units, at least two image acquiring units of the plurality of image acquiring units being adapted to respectively acquire images of container numbers on at least two surfaces

of a plurality of surfaces of the container passing through the passageway; and

a number identification device configured to identify the container number at least based on the images or data from the at least two image acquiring units about the container number, wherein

a distance between projections of the at least two image acquiring units in a movement direction of the container relative to the passageway is less than the length of the container.

12. The system according to claim 11, wherein:

the trigger unit comprises a first group of sensors including a first signal receiving portion configured to sense a position of the container relative to the passageway;

the at least two image acquiring units comprise a first image acquiring unit and a second image acquiring unit adapted to respectively acquire images of the container numbers on a front surface and a rear surface of the container, the first image acquiring unit and the second image acquiring unit being located on either side of a first signal path of the first group of sensors respectively.

13. The system according to claim 12, wherein:

a midpoint of a connection line between the first image acquiring unit and the second image acquiring unit is a midpoint of the first signal path.

14. The system according to claim 11, wherein:

the trigger unit comprises a second group of sensors and a third group of sensors arranged to space apart from each other in the movement direction, the second group of sensors including a second signal receiving portion configured to sense a position of the container relative to the passageway, the third group of sensors including a third signal receiving portion configured to sense the position of the container relative to the passageway;

the at least two image acquiring units comprise a first image acquiring unit and a second image acquiring unit adapted to respectively acquire images of the container numbers on a front surface and a rear surface of the container, the first image acquiring unit and the second image acquiring unit being located on either side of a first signal path of the first group of sensors respectively.

15. The system according to claim 14, wherein:

the at least two image acquiring units further comprises a third image acquiring unit adapted to acquire an image of a container number on one side surface of the container.

16. The system according to claim 15, wherein:

the at least two image acquiring units further comprises a fourth image acquiring unit adapted to acquire an image of a container number on another side surface of the container.

17. The system according to claim 16, wherein:

a midpoint of a connection line between the first image acquiring unit and the second image acquiring unit is also a midpoint of a connection line between the third image acquiring unit and the fourth image acquiring unit.

18. The system according to claim 14, wherein:

the trigger unit further comprises a first group of sensors including a first signal receiving portion configured to sense the position of the container relative to the passageway, the first group of sensors being located between the second group of sensors and the third group of sensors in the movement direction of the container;

the at least two image acquiring units further comprises a third image acquiring unit adapted to acquire an image of a container number on one side surface of the container and a fourth image acquiring unit adapted to acquire an image of a container number on another side surface of the container.

19. The system according to claim 18, wherein:

the first group of sensors is located at an intermediate position between the second group of sensors and the third group of sensors in the movement direction; and

a midpoint of a connection line between the first image acquiring unit and the second image acquiring unit is also a midpoint of the first signal path and a midpoint of a connection line between the third image acquiring unit and the fourth image acquiring unit.

20. The system according to any one of claims 11-19, wherein the system further comprises a carrying vehicle, which defines the passageway and on which the image acquiring device is arranged; and/or.

the trigger unit is configured to generate a signal based on a relative movement between the container and the passageway.