embodiment has a distance sensor 1 (measurement means or measurement portion), a shape recognition portion 2, an arrangement storage portion 3, and a load collapse determination portion 4 (load collapse determination means) and a display portion 5. Furthermore, the shape recognition portion 2, the arrangement storage portion 3, and the load collapse determination portion 4 are configured as one function of an arithmetic device P. The arithmetic device P is a computer configured with a central processing unit (CPU), memory such as random access memory (RAM) and read only memory (ROM), and an input/output device that exchanges signals with an external device, and the like. As an example of the arithmetic device P, there is an electric control unit (ECU) mounted on the transportation vehicle T to control an internal combustion engine, an electric motor, a transmission, and the like, or a combination thereof. Therefore, as an algorithm executed by the computer or the ECU which is an example thereof, the functions of the shape recognition portion 2, the arrangement storage portion 3, and the load collapse determination portion 4 may be implemented. Furthermore, the shape recognition portion 2, the arrangement storage portion 3, and the load collapse determination portion 4 may each be a computer configured with a CPU, memory such as RAM and ROM, an input/output device that exchanges signals with an external device, and the like. In this case, the functions of the shape recognition portion 2, the arrangement storage portion 3, and the load collapse determination portion 4 may be implemented as an algorithm executed by each computer provided in the shape recognition portion 2, the arrangement storage portion 3, and the load collapse determination portion 4.

[0016]

The distance sensor 1 is provided at an upper part of the trailer head H of the transportation vehicle T (vehicle), for example, as shown in Figs. 1 and 2. The distance sensor 1 is a device capable of detecting a distance to a target by irradiating the target

with a pulsed laser light and measuring a time period until the light reflected from the target reaches the distance sensor 1. Furthermore, the distance sensor 1 mounted at a front side in a traveling direction can scan a region including the front and the rear of the transportation vehicle T, and can also detect an obstacle R by measuring a distance to the obstacle R that may exist around the transportation vehicle T including the front of the transportation vehicle T and that can obstruct the operation of the transportation vehicle T. It is assumed that the obstacle R is, for example, a utility pole, a wall of a tunnel, a railroad crossing or parking lot barrier, a median strip, another parked vehicle, another driving vehicle, a guard temporarily provided on a road surface under construction, and the like. The distance sensor 1 is, for example, a two-dimensional or three-dimensional laser range finder (LRF) or a two-dimensional or three-dimensional light detection and ranging or laser imaging detection and ranging (LIDAR). In addition, the data of a sensor used for simultaneous localization and mapping (SLAM) may be applied to the distance sensor 1. An object for which the distance sensor 1 measures a distance may be collectively referred to as a surrounding body. That is, the surrounding body includes the obstacle R, the transportation target C, the loading platform N, a ground G (road surface), and the like.

[0017]

The shape recognition portion 2 identifies an outer shape from a data point cloud based on measurement data acquired from the distance sensor 1. Here, the measurement data is, for example, data showing a distance to a target measured by the distance sensor 1. When this data is visualized, a plurality of measurement points, which are points on a surface of the target whose distance to the distance sensor 1 is measured by irradiating the surface of the target with pulsed laser light are displayed as points on the target. This plurality of points is referred to as a data point cloud. The shape recognition portion 2 groups (makes a set of) continuous measurement points having close heights based on the

displays a warning or the like in a case where it is determined as a load collapse. Furthermore, in a case where an operator is present in the transportation vehicle T, a warning may be displayed on a windshield of a driver's seat, a vehicle-mounted monitor, or the like. Furthermore, the central control equipment or the like refers to an equipment that allows an observer to constantly monitor, for example, driving status such as the presence or absence of a load collapse in an unmanned transportation vehicle. As necessary, an instruction such as stop may be transmitted from the central control equipment or the like to the unmanned transportation vehicle. In addition, the central control equipment or the like may monitor a plurality of unmanned transportation vehicles at the same time.

[0021]

A flow of the load collapse determination in the drive control system S will be described with reference to Fig. 3.

The distance sensor 1 measures a distance to a point cloud of the measurement points of the transportation target C (step S1).

Then, the shape recognition portion 2 compares the heights of the acquired point clouds in a vertical direction, and groups the measurement points having close distances and close heights of the point clouds (i.e., in which a difference in distance and height is of a predetermined value or less) (step S2).

[0022]

Then, the arrangement storage portion 3 stores the measurement points grouped by the shape recognition portion 2 (step S3). Moreover, the load collapse determination portion 4 determines whether the group in a current frame is linear (step S4). In the step S4, in a case where the determination is NO, that is, in a case where the group is not linear, determination is not performed.

[0023]

In the step S4, in a case where the determination is YES, that is, in a case where the group is linear, the load collapse determination portion 4 determines whether a difference between the arrangement of a group (G1) of measurement points in a current frame, and the arrangement of a group (G2) of measurement points whose position is close to the group (G1) of the measurement points in the current frame in an immediately previous frame stored in the arrangement storage portion 3 is at a threshold value or greater (step S5). In the step S5, in a case where the determination is YES, that is, in a case where a difference in arrangement is at the threshold value or greater, it is determined that a load collapse has occurred, and a warning is displayed on the display portion 5 (step S6). In addition, in a case where the determination is NO in the step S5, that is, in a case where the difference in arrangement is less than the threshold value, it is determined that a load collapse has not occurred.

[0024]

Furthermore, in a case where the transportation vehicle T turns or the like, there may be a case where a connection angle between the trailer head H and the transportation target C changes. In such a case, a change in the arrangement of the transportation target C can be detected by acquiring a value of the connection angle between the trailer head H and the transportation target C from a sensor (e.g., angle sensor) provided on the transportation vehicle T to measure the connection angle, and correcting measurement data acquired by the distance sensor 1 by the connection angle.

[0025]

According to the present embodiment, the arrangement of the transportation target C can be detected using the distance sensor 1 that also serves as an obstacle detection sensor to determine a load collapse by the load collapse determination portion 4.

recognized by the driver of the transportation vehicle T or on a windshield.

[0032]

(5) Furthermore, in the above embodiment, it is determined that a load collapse has occurred, but a state where the transportation target C is losing its balance can be detected by reducing a threshold value of change in the arrangement of the transportation target C. Thus, the occurrence of a load collapse of the transportation target C can be predicted or it is possible to issue a warning at a stage when a deviation, which may grow into a load collapse in the future, occurs.

[0033]

(6) In the above embodiment, the warning information of a load collapse is displayed on the display portion, but the present disclosure is not limited thereto. The warning information of the load collapse may be notified as voice to a manager of the unmanned transportation vehicle or the driver of the manned transportation vehicle.

[0034]

(7) In the above embodiment, as shown in Fig. 2, it is assumed that the number of transportation targets C is one, but the present disclosure is not limited thereto, and a load collapse can be determined even when there are a plurality of transportation targets C.

[Industrial Applicability]

[0035]

According to a drive control system of the present disclosure, it is possible to determine a load collapse of a transportation target with a simple configuration based on measurement data of a measurement portion that detects an obstacle by a load collapse determination portion.

[Reference Signs List]

[0036]

[CLAIMS]

[Claim 1]

A drive control system comprising:

a measurement portion configured to detect a transportation target in a transportation vehicle; and

a load collapse determination portion configured to acquire an arrangement of a transportation target loaded on the transportation vehicle based on measurement data of the measurement portion to determine a load collapse of the transportation target based on a change in the arrangement over time, wherein

the transportation vehicle includes:

a trailer head provided with the measurement portion; and

a loading platform on which the transportation target is loaded and which is connected to the trailer head, and

the load collapse determination portion detects a change in the arrangement of the transportation target by correcting a measurement data acquired by the measurement portion by a connection angle between the trailer head and the transportation target in a case where the transportation vehicle turns.

[Claim 2]

The drive control system according to Claim 1, wherein the measurement portion performs scanning with laser light to measure a distance between the trailer head and a surrounding body.

[Claim 3]

The drive control system according to Claim 2, wherein the load collapse determination portion uses a set of a plurality of continuous linear measurement points in an outer shape of the transportation target as a reference for the arrangement of the transportation target.

[Claim 4]

The drive control system according to any one of Claims 1 to 3, wherein the measurement portion is provided at an upper part of the trailer head.

[Claim 5]

The drive control system according to any one of Claims 1 to 3, wherein the measurement portion is provided at each of left and right ends of the trailer head.