DESCRIPTION

TRAVEL CONTROL DEVICE

FIELD

[0001] An embodiment of the present invention relates to a travel control device.

BACKGROUND

[0002] Conventionally, in order to stop a train at a predetermined stop position, an object, such as a stop sign, is placed in the vicinity of a track in some cases. Various kinds of control methods have been developed to automatically stop the train at the stop position specified by the object in such cases.

CITATION LIST

Patent Literature

[0003] Patent Literature 1: Japanese Patent Application Laid-open No. 2018-19470

SUMMARY OF THE INVENTION

Problem to be Solved by the Invention

[0004] However, in such conventional techniques, there is room for improvement in, for example, accuracy of the stop position of the train. Therefore, an object of the present embodiment is to stop a train with high accuracy at a stop position specified by an object.

Means for Solving Problem

[0005] A travel control device of an embodiment includes a detection unit, a relative distance calculation unit, a speed information acquisition unit, a movement distance calculation unit, and a travel control unit. The detection unit detects, from a captured image obtained by capturing an

area ahead of the train by an image capturing unit provided in the train, an object existing in a vicinity of a track of a train and indicating a stop position of the train. The relative distance calculation unit calculates a relative distance between the train and the object, based on a detection result of the object by the detection unit. The speed information acquisition unit obtains speed information of the train. The movement distance calculation unit calculates a movement distance of the train, based on the speed information obtained by the speed information acquisition unit. The travel control unit controls travel of the train such that the train stops at the stop position specified by the object. The control of the travel of the train is performed based on: the relative distance calculated by the relative distance calculation unit when the object is detected by the detection unit; and the movement distance calculated by the movement distance calculation unit by changing control after a predetermined condition is satisfied.

BRIEF DESCRIPTION OF DRAWINGS

[0006] FIG. 1 is a diagram illustrating a schematic configuration of a railway vehicle according to the present embodiment.

FIG. 2 is a block diagram illustrating a functional configuration of a travel control device of the railway vehicle according to the present embodiment.

FIG. 3 is a schematic diagram illustrating a situation where an object is out of a captured image when the train approaches the object in the present embodiment.

FIG. 4 is a schematic diagram illustrating captured images in the present embodiment.

FIG. 5 is a flowchart of travel control by the travel control device according to the present embodiment.

DETAILED DESCRIPTION

[0007] Hereinafter, with reference to the accompanying drawings, description will be

[0028] Thereafter, as illustrated in FIG. 3(c), the railway vehicle RV2 stops at a time when the front end has reached a side of the object 61.

[0029] Next, referring to FIG. 5, travel control by the travel control device 20 will be described. FIG. 5 is a flowchart of the travel control by the travel control device 20 according to the present embodiment. First, at step S1, the image acquisition unit 201 obtains a captured image from the camera 10.

[0030] Next, at step S2, the detection unit 202 determines whether an object has been detected in the captured image obtained at step S1. In the case of "Yes", the travel control proceeds to step S3, and, in the case of "No", the travel control returns to step S1.

[0031] At step S3, the image acquisition unit 201 obtains a captured image from the camera 10. Next, at step S4, the relative distance calculation unit 203 calculates a relative distance between the railway vehicle RV and the object, based on the captured image obtained at step S3.

[0032] Next, at step S5, the travel control unit 206 controls travel of the railway vehicle RV, based on the relative distance calculated at step S4. That is, the travel control unit 206 controls travel of the railway vehicle RV so as to slow a speed as the railway vehicle RV approaches the object.

[0033] Next, at step S6, the travel control unit 206 determines whether a predetermined condition (for example, one of Conditions 1 to 4 described above) has been satisfied. In the case of "Yes", the travel control proceeds to step S7, and, in the case of "No", the travel control returns to step S3.

[0034] At step S7, the speed information acquisition unit 204 obtains, from the speed sensor 50, speed information of the railway vehicle RV.

[0035] Next, at step S8, the movement distance calculation unit 205 calculates a movement distance of the railway vehicle RV, based on the speed information obtained at step S7.

[0036] Next, at step S9, in order to stop the railway vehicle RV at the stop position

the other railway vehicle. In such a case, the detection unit 202 detects the second train (RV1) that exists ahead of the railway vehicle RV2 in a captured image. When the detection unit 202 detects the second train (RV1) existing ahead of the railway vehicle RV2, the travel control unit 206 controls travel of the railway vehicle RV2 to stop the railway vehicle RV2 based on the object in a range that can keep a relative distance to the second train (RV1) equal to or larger than a first threshold.

[0045] This makes it possible to flexibly perform stop control of the railway vehicle RV depending on whether a second railway vehicle exists ahead.

[0046] It should be noted that a computer program executed by the travel control device 20 according to the present embodiment is provided in a form incorporated in a component such as the ROM in advance. The computer program executed by the travel control device 20 according to the present embodiment may be provided in a file of an installable format or an executable format that is recorded on a recording medium, such as a CD-ROM, a flexible disk (FD), a CD-R, and a digital versatile disc (DVD), which can be read by computers.

[0047] Furthermore, the computer program executed by the travel control device 20 according to the present embodiment may be provided by storing the computer program in a computer connected to a network such as the Internet and downloading the computer program via the network. The computer program executed by the travel control device 20 according to the present embodiment may be provided or distributed via a network such as the Internet.

[0048] The computer program executed by the travel control device 20 according to the present embodiment has a module configuration including the above-described components 201 to 206. As actual hardware, the CPU reads the computer program from the ROM and executes the computer program so that the components are loaded on a main storage device, and that the components 201 to 206 are generated on the main storage device.

[0049] The embodiment of the present invention and the modifications that have been

CLAIMS

1. A travel control device comprising:

a detection unit for detecting, from a captured image obtained by capturing an area ahead of the train by an image capturing unit provided in the train, an object existing in a vicinity of a track of a train and indicating a stop position of the train;

a relative distance calculation unit for calculating a relative distance between the train and the object, based on a detection result of the object by the detection unit;

a speed information acquisition unit for obtaining speed information of the train;

a movement distance calculation unit for calculating a movement distance of the train, based on the speed information obtained by the speed information acquisition unit; and

a travel control unit for controlling travel of the train such that the train stops at the stop position specified by the object, wherein the control of the travel of the train is performed based on

the relative distance calculated by the relative distance calculation unit when the object is detected by the detection unit, and

the movement distance calculated by the movement distance calculation unit by changing control after a predetermined condition is satisfied.

2. The travel control device according to claim 1, wherein the speed information acquisition unit obtains the speed information based on at least one of: a rotational speed of wheels of the train obtained from a wheel speed sensor; acceleration information obtained from an acceleration sensor; and information on a distance to the object obtained by a distance measurement device.

3. The travel control device according to claim 1, wherein

the detection unit detects a second train existing ahead of the train in the

captured image, and,

the travel control unit controls, when the detection unit detects a second train existing ahead of the train, travel of the train such that the train stops in a state that a relative distance to the second train is equal to or larger than a first threshold.

4. The travel control device according to claim 1, wherein

the image capturing unit is a stereo camera, and

the relative distance calculation unit calculates the relative distance between the train and the object, based on parallax of the object in a plurality of the captured images obtained by image capturing using the stereo camera.

5. The travel control device according to claim 1, wherein the predetermined condition is one of conditions that:

the object has been out of the captured image;

the object has moved to a predetermined position in the captured image;

the object has become a predetermined size or larger in the captured image; and

the relative distance calculated by the relative distance calculation unit has become a second threshold or smaller.