

DESCRIPTION

Title of the Invention

RAILWAY OPERATION INFORMATION CHANGE SYSTEM, RAILWAY
OPERATION INFORMATION MANAGEMENT SYSTEM, AND RAILWAY
OPERATION INFORMATION CHANGE METHOD

Technical Field

[0001]

The present technology relates to a railway
operation information change system, a railway operation
information management system, and a railway operation
information change method.

Background Art

[0002]

Regarding information required for railway
operation, in Patent Literature 1, there is disclosed a
technology of directly making a change to a desired
timetable line while viewing a timetable line of a train
timetable on a display screen without necessity of input of
numerical-value data for changing the timetable. In Patent
Literature 1, a description is made such that "a train
timetable creation device provided with a timetable memory
that stores timetable line data indicating an operation of

a train, control timetable display control means 11 that displays the timetable line data in this timetable memory on a display screen, arrival and departure change determination means 13 that determines, from a coordinate position of a certain specified input point on the timetable line displayed on this display screen, whether a change relates to arrival or departure as well as a station name, changed time calculation means 14 that calculates, when a coordinate position in a time direction is specified from the coordinate position of the specified input point, this changed time in the time direction, and update means 15 that updates and displays a timetable line to be changed on the basis of this calculated changed time."

Citation List

Patent Literature

[0003]

[Patent Literature 1] JP-1994-321111-A

Summary of the Invention

Problem to be Solved by the Invention

[0004]

In Patent Literature 1, timetable data is changed by using a mouse operation to move the timetable line in the timetable change system. However, it is not possible to

unitarily make a change of various types of data to be changed such as a change being made at once in information relating to an operation plan according to a change in the operation plan. Moreover, for a user (for example, a dispatcher) to recognize an operation state, it is required to acquire required information from charts on a plurality of displays having display contents which are being successively changed, and to associate the acquired pieces of information with one another, and the acquisition and the association of the information is high in work load on the user. Thus, there has been desired a technology which can display a plurality of pieces of railway operation information such that the information can more intuitively be understood by the user than conventional. Further, it is required to execute, on each display, a data change operation for trainrailwaytrain operation adjustment. However, according to a conventional technology including the technology described in Patent Literature 1, it is not possible to make a unitary change in data such as a change spanning over a plurality of pieces of information. Thus, there has been desired a technology with which the user unitarily accesses the plurality of pieces of railway operation information, thereby changing the data.

[0005]

Thus, the present invention has an object to provide

a technology with which a user can intuitively understand a plurality of piece of displayed railway operation information, and can unitarily make access to the plurality of pieces of railway operation information, thereby changing data.

Means for Solving the Problem

[0006]

A railway operation information change system according to the present invention is a railway operation information change system that changes information relating to railway operation displayed in a virtual space, by a computer including a processor and a memory, in which the processor: acquires information relating to a change operation made to an operation via an avatar displayed in the virtual space for virtual space display data created on the basis of the information relating to the railway operation and a visualization rule that defines a visualization rule for data in order to display the data in the virtual space, and stores the acquired information in the memory; determines a type of the change operation on the basis of the acquired information relating to the change operation; creates candidate nodes that serve as change destinations of the change operation made to the virtual space display data, on the basis of the determined

type and a data change rule that indicates a rule for the change operation according to the type and the information relating to the railway operation defined in advance, and stores the created candidate nodes in the memory ; and determines, on the basis of an operation on the created candidate node via the avatar, a node on which the change operation has been made out of the created candidate nodes, and updates the information relating to the railway operation that includes a node that satisfies a predetermined condition for the determined node.

Advantages of the Invention

[0007]

According to the present invention, a user can intuitively understand a plurality of piece of displayed railway operation information, and can unitarily make access to the plurality of pieces of railway operation information, thereby changing data.

Brief Description of the Drawings

[0008]

[FIG. 1] FIG. 1 includes a block diagram of a railway operation information change system and a diagram for illustrating an example of related systems connected to the railway operation information change system.

[FIG. 2] FIG. 2 is a diagram for illustrating a hardware configuration example of the railway operation information change system.

[FIG. 3] FIG. 3 is a flowchart for illustrating an example of a processing procedure of overall processing executed by the railway operation information change system.

[FIG. 4] FIG. 4 is a flowchart for illustrating an example of a processing procedure of change destination candidate node creation processing.

[FIG. 5] FIG. 5 is a flowchart for illustrating an example of a processing procedure of data change reflection processing.

[FIG. 6] FIG. 6 is a flowchart for illustrating an example of a processing procedure of railway operation information update processing.

[FIG. 7] FIG. 7 is a view for illustrating a display output example in a virtual space (plurality-of-timetable display example).

[FIG. 8] FIG. 8 is a view for illustrating a display output example in the virtual space (track information display example).

[FIG. 9] FIG. 9 is a view for illustrating a display output example in the virtual space (vehicle depot information display example).

[FIG. 10] FIG. 10 is a view for illustrating a display output example in the virtual space (proposed trainrailwaytrain operation adjustment rescheduling plan display example).

[FIG. 11] FIG. 11 is a view for illustrating a display output example in the virtual space (vehicle operation information display example).

[FIG. 12A] FIG. 12A is a table for illustrating an example of operation plan information on a train (Tr01) operating on a certain line L1.

[FIG. 12B] FIG. 12B is a table for illustrating an example of operation plan information on a train (Tr02) operating on another certain line L2.

[FIG. 13] FIG. 13 is a table for illustrating an example of a track information being one of pieces of railway operation information.

[FIG. 14] FIG. 14 is a table for illustrating an example of a vehicle depot information being one of the pieces of railway operation information.

[FIG. 15] FIG. 15 is a table for illustrating an example of a vehicle operation information being one of the pieces of railway operation information.

[FIG. 16] FIG. 16 is a table for illustrating an example of a visualization frame.

[FIG. 17] FIG. 17 is a table for illustrating an

example of virtual space display data when the operation plan information is assigned to the visualization frame.

[FIG. 18] FIG. 18 is a table for illustrating an example of avatar operation information when an avatar operation is executed on the virtual space display data.

[FIG. 19] FIG. 19 is a table for illustrating an example of operation target type information.

[FIG. 20] FIG. 20 is a diagram for illustrating an example of a data change rule list.

[FIG. 21] FIG. 21 is a table for illustrating an example of data change rules.

[FIG. 22] FIG. 22 is a table for illustrating an example of change target data information.

[FIG. 23] FIG. 23 is a table for illustrating an example of change destination candidate data ranges.

[FIG. 24] FIG. 24 is a table for illustrating an example of change destination candidate data information.

[FIG. 25] FIG. 25 is a table for illustrating an example of change destination candidate nodes.

[FIG. 26] FIG. 26 is a table for illustrating an example of a change destination node.

Modes for Carrying Out the Invention

[0009]

A description is now given of embodiments according

to the present invention with reference to the drawings. The following description and drawings are exemplified for describing the present invention, and are appropriately omitted and simplified for clarifying the description. The present invention can also be embodied in other various forms. Each component may be plural or singular unless otherwise specified.

[0010]

A position, a size, a shape, a range, and the like of the component illustrated in the drawings sometimes do not represent actual position, size, shape, range and the like for promoting understanding of the invention. Thus, the present invention is not necessarily limited to the position, the size, the shape, the range, and the like disclosed in the drawings.

[0011]

In the following description, various types of information are sometimes described through expressions such as "database," "table," "list," and the like, but the various types of information may be expressed in data structures other than them. In order to indicate independence of the data structure, "XX table," "XX list," and the like are sometimes referred to as "XX information." When identification information is described, in a case in which expressions such as "identification information,"

"identifier," "name," "ID," and "number" are used, they are interchangeable.

[0012]

In a case in which there exist a plurality of components having the same function or similar functions, a description is sometimes given while different appendices are attached to the same reference sign. However, in a case in which it is not required to distinguish each of the plurality of components from another one, a description is sometimes given while the appendices are omitted.

[0013]

Moreover, in the description given below, there is a case in which a description is given of processing implemented by executing a program, the program is executed by a processor (for example, a CPU or a GPU (Graphic Processing Unit)) to carry out defined processing while appropriately using storage resources (for example, a memory), interface devices (for example, a communication port), and/or the like, and hence a subject of the processing may be the processor. Similarly, the subject of the processing implemented by executing the program may be a controller, a device, a system, a computer, or a node including the processor. It is only required that the subject of the processing implemented by executing the program is an arithmetic operation unit, and may include a

dedicated circuit (for example, an FPGA (Field-Programmable Gate Array) or an ASIC (Application Specific Integrated Circuit) which executes specific processing.

[0014]

The program may be installed in a device such as a computer from a program source. The program source may be, for example, a program distribution server or a computer-readable storage medium. In a case in which the program source is the program distribution server, the program distribution server may include a processor and a storage resource which stores the program to be distributed, and the processor of the program distribution server may distribute the program to be distributed to another computer. Moreover, in the description given below, two or more programs may be implemented as one program, and one program may be implemented as two or more programs.

[0015]

Moreover, in the description given below, although there is exemplified a case in which the present system is implemented by one certain computer, all of or a part of functions of this system may be provided to one or a plurality of computers such as a cloud in a distributed manner, and similar functions may be implemented through mutual communication via a network.

[First Embodiment]

[0016]

FIG. 1 includes a block diagram of a railway operation information change system 100 according to a present embodiment and a diagram for illustrating an example of related systems connected to the railway operation information change system 100. The railway operation information change system 100 is a system which executes trainrailwaytrain operation adjustment operations for railway transport commands. The trainrailwaytrain operation adjustment operations are operations which change an operation plan for trains in a case in which the operation plan is disrupted by a cause such as a delay of a train, and are operations of changing various operation plans relating to railway transport, such as an operation of switching travel orders of trains, an operation of changing a stop time, an operation of changing a vehicle allocation, an operation of changing a departure track and an arrival track, and an operation of stopping an operation.

[0017]

The railway operation information change system 100 is formed of a railway operation information acquisition unit 101, an avatar operation information acquisition unit 102, a data display control unit 103, a data change unit 104, and a data storage unit 105. The data display control

unit 103 is formed of a virtual space display data determination unit 1031, a virtual space display data creation unit 1032, and a display data output unit 1033. The data change unit 104 is formed of a data change reception unit 1041, an operation target type determination unit 1042, a change destination candidate node creation unit 1043, and a data change reflection unit 1044. The data storage unit 105 stores railway operation information 1051, avatar operation information 1052, visualization frames 1053, a data change rule list 1054, virtual space display data 1055, operation target type information 1056, change destination candidate nodes 1057, data change rules 1058, a change target data information 1059, change destination candidate data ranges 1060, change destination candidate data information 1061, and a change destination node 1062.

[0018]

The railway operation information 1051 is stored by the railway operation information acquisition unit 101, and the avatar operation information 1052 is stored by the avatar operation information acquisition unit 102. The railway operation information 1051 includes railway operation system static information and railway operation system dynamic information. The railway operation information 1051 is information widely required to execute

railway operation, and is information stored in the various railway operation systems. The railway operation information 1051 includes various types of information used for the railway operation, such as operation plan information which indicates a station and a time of arrival at this station and a time of departure from this station, track information which indicates the number of a platform of a station which a train arrives at and departs from, vehicle depot information which indicates a place at which storage, construction, maintenance, and the like is executed for a train, vehicle operation information which indicates allocation of a vehicle used for an operation plan for a train indicated by operation plan information, a timetable diagram being a line diagram (for example, a diagram in which a position is assigned to a vertical axis, and time is assigned to a horizontal axis, and which describes a position of a train at each time as train line) expressing the operation plan for a train indicated by the operation plan information, and proposed trainrailwaytrain operation adjustment rescheduling plan information which is obtained by changing the operation plan disrupted by a delay of a train or the like. The railway operation system static information is information which is, out of the railway operation information 1051, defined independently of a time zone in which the railway operation is executed, and

includes, for example, the track information and the vehicle operation information described above. The railway operation system dynamic information is information which is, out of the railway operation information 1051, defined according to the time zone in which the railway operation is executed, and includes, for example, the operation plan information, the vehicle depot information, the timetable diagram, and the proposed trainrailwaytrain operation adjustment rescheduling plan information described above. As described above, the railway operation information 1051 includes not only the information in an operation time zone being the time zone in which the train is operated according to a day-to-day timetable such as the operation plan and an operation record of the train, but also the information in a time zone other than the day-to-day operation time zone such as a train maintenance time zone and a train inspection time zone after the operation time zone.

[0019]

The virtual space display data 1055 is created by the data display control unit 103 through use of the visualization frame 1053, and is then stored. The visualization frame 1053 and the data change rule list 1054 are stored in advance. The virtual space display data 1055 and the operation target type information 1056 are data

used for display in processing described later.

[0020]

The railway operation information change system 100 is connected to a railway operation system 200 via a communication network N1. In the railway operation system 200, various types of the railway operation information 1051 are held. This is a system which distributes data required by the railway operation information change system 100. The railway operation system 200 refers to an entire system required for the railway operation, and includes, as examples, an operation management system, a vehicle management system, and a people flow information system. The operation management system is a system which manages an operation of a train as described in JP-2005-138710-A. The operation management system manages information on train positions, surveillance cameras in stations, level crossings, and the like which can be acquired from ground systems of the railway. The vehicle management system is a system which manages vehicles of a railway as described in JP-2022-536059-T. The vehicle management system manages information on speeds, load weights, vehicle cameras, and the like which can be acquired from a vehicle system of the railway. The people flow information system is a system which manages information on railway users as described in JP-2002-187551-A and JP-2014-206829-A. The people flow

information system manages information relating to the railway users such as probe data, ticket gate data, SNS data, and travel line search results.

[0021]

Moreover, the railway operation information change system 100 is connected to a user terminal 300 via a communication network N2, transmits information to be displayed on an output screen of the user terminal 300, and acquires operation information on the user terminal 300. On the user terminal 300, a virtual space is displayed, and an avatar in the virtual space is operated. Here, the virtual space refers to a space virtually built through a digital technology. In particular, as the virtual space, not a plane, but a three-dimensional space having a depth is mainly targeted. Moreover, the avatar refers to an agent which moves around in the virtual space, and is operated by the user. The avatar reproduces operations and characteristic portions and motions of the user in the virtual space, and reproduces, for example, portions and motions of the arms, the hands, and the fingers of the user. The output device of the user terminal 300 may be a device such as a head-mounted display which blocks the field of view with a display or a device such as a BMI (brain machine interface) which causes the field of view to be directly displayed in the brain. An input device of the

user terminal 300 operates the avatar, and may be a controller, a sensor which recognizes hand gestures of the user, a BMI which acquires information in the brain, or the like. The user terminal 300 is managed by, for example, a transportation operator which operates predetermined transportation, and is used by a system user who uses the railway operation information change system 100, for example, a dispatcher of the transportation operator, who is the user of the present system. The communication networks N1 and N2 may be a common network or may be networks which uses protocols different from each other.

[0022]

FIG. 2 is a diagram for illustrating a hardware configuration example of the railway operation information change system 100. The railway operation information change system 100 is formed of a device which can execute various types of information processing, for example, an information processing device such as a computer. The railway operation information change system 100 includes a storage device 500, a memory 510, an arithmetic operation device (hereinafter simply referred to as CPU) 511 represented by a CPU, a UI device 512, and a communication device 513.

[0023]

The storage device 500 is a nonvolatile storage

device such as an SSD (Solid State Drive) or a hard disk drive, and holds, as data, the data 1051 to 1062 (see FIG. 1) required for execution of the function modules and generated by the function modules and the like, as well as programs which implement the units 101 to 104 (see FIG. 1) being function modules executed by the railway operation information change system 100.

[0024]

The memory 510 is the volatile memory such as a RAM (Random Access Memory). The CPU 511 reads the programs described above from the storage device 500 at an operation start time (for example, at a time of turning on a power supply) of the railway operation information change system 100, and deploys and executes the programs on the memory 510. The UI device 512 is connected to an input device such as a keyboard, a mouse, and a controller and an output device such as a display, not illustrated, and implements a GUI. The communication device 513 executes communication processing to and from the relating systems via the networks N1 and N2.

[0025]

Note that each of the railway operation system 200 including the operation management system, the vehicle management system, and the people flow information system and the user terminal 300 illustrated in FIG. 1 also has,

as hardware, a general configuration similar to that of the railway operation information change system 100. The entire system including the railway operation information change system 100, the railway operation system 200, and the user terminal 300 may be referred to as railway operation information management system. This management includes various types of processing described below such as data acquisition from the railway operation system 200, update of the railway operation system 200, processing in the railway operation information change system 100, display of data on the user terminal 300, and input from the user terminal 300.

[0026]

FIG. 3 is a flowchart for illustrating an example of a processing procedure of overall processing executed by the function modules of the railway operation information change system 100. The railway operation information change system 100 starts this processing at a timing of reception of a start instruction received from the user terminal 300, and is assumed to be in a state in which this processing is always being executed after this start instruction is received. That is, it is assumed that the railway operation information change system 100 repeatedly executes processing of each step described below until a finish instruction is received from the user terminal 300

(S301 and S314).

[0027]

First, the railway operation information acquisition unit 101 acquires the latest railway operation information 1051 from the railway operation system 200 (S302). After that, the virtual space display data creation unit 1032 uses the acquired latest railway operation information 1051 and the visualization frame 1053 stored in advance to create the virtual space display data 1055 (S303). The visualization frame 1053 is information which indicates visualization rules for data in order to display the data in the virtual space. The visualization frame 1053 is designed in advance according to instruction operation of the railway operation operator and various types of the railway operation information 1051 and is stored, for input data required for the display in the virtual space and the visualization rules for the data to be displayed in the virtual space. As the visualization rule for the data, there is stored, for example, a display method which reads and uses a three-dimensional space of the virtual space. As a result, the railway operation information change system 100 can prepare, in advance, railway information to be displayed and the visualization method.

[0028]

For example, the virtual space display data creation

unit 1032 extracts the visualization frame 1053 matching the railway operation information 1051 required to be displayed in the virtual space, and assigns values of the railway operation information 1051 to the visualization frame 1053. Further, the virtual space display data creation unit 1032 determines a display position of the visualization frame 1053 after the assignment, and creates the virtual space display data 1055 including the visualization frame 1053 at the determined display position and objects to be displayed in the virtual space together with this visualization frame. The virtual space display data 1055 is data which indicates structure, a position (for example, coordinates), and a display form of the object to be displayed in the virtual space including the object to be displayed in the virtual space and the visualization frame used to display this object. Regarding the extraction of the matching visualization frame 1053, for example, in a case in which information on various items stored as the railway operation information 1051 is stored as object data of the visualization frame 1053, it is only required to extract this visualization frame as the visualization frame 1053 matching the railway operation information 1051 described above. The configuration is not limited to this example, and any method may be used for detailed processing.

[0029]

The display data output unit 1033 transmits the virtual space display data 1055 created in S303 to the user terminal 300 (S304). As a result, the railway operation information change system 100 can display the created virtual space display data 1055 on the output device such as the display of the user terminal 300.

[0030]

After that, the data change reception unit 1041 determines whether or not a change operation request for the virtual space display data 1055 displayed in S304 has been made from the user terminal 300 (S305). The change operation request described above is such a request that the dispatcher being the user changes the position or the display form of the object or the visualization frame of the virtual space display data 1055, and is implemented by, for example, pressing a button displayed on the screen in order to receive a change operation directed to the virtual space display data 1055 of the user terminal 300.

[0031]

In a case in which the data change reception unit 1041 determines that the change operation request described above has been made (Yes in S305), the avatar operation information acquisition unit 102 acquires the avatar operation information 1052 from the user terminal 300, that

is, the information acquired from the input device of the user terminal 300 (S306). The avatar operation refers to an operation directed to the virtual space such as touching each element (for example, the object displayed in the virtual space) in the virtual space, moving each element, moving a position of the avatar in the virtual space, and changing a line of sight in the virtual space. On this occasion, the avatar operation information acquisition unit 102 writes the avatar operation in an avatar operation log. [0032]

The operation target type determination unit 1042 reads the avatar operation information 1052 acquired in S306, determines an operation target type indicating on which object or visualization frame included in the virtual space display data 1055 the operation included in the avatar operation information 1052 has been executed, and creates the operation target type information 1056 including the determined operation target type (S307). [0033]

The operation target type information 1056 is information which defines the operation target type which indicates the type of the visualization frame or the object operated by the operation included in the avatar operation information 1052, operation target data being data for displaying the visualization frame or the object of this

operation target type, and operation target source railway operation information indicating the railway operation information 1051 including this operation target data. The operation target type includes the various types of information stored as the railway operation system dynamic information in the railway operation information 1051, such as information relating to a departure time and an arrival time of a train included in the operation plan information, information relating to a departure station and an arrival station, and information relating to a depot entry time and a depot entry track of a train included in the vehicle depot information. Moreover, for example, the operation target type includes the various types of information stored as the railway operation system static information in the railway operation information 1051, such as information relating to a station and tracks of this station included in the track information and information relating to the formation of the train included in the vehicle operation information. The operation target data and the operation target source railway operation information also similarly include the various types of information. As a determination method for the operation target type, any method can be used.

[0034]

In S307, for example, the operation target type

determination unit 1042 may read the object of the operation target or the operation position included in the avatar operation information 1052, and may automatically output a result thereof as the operation target type information 1056, thereby determining the operation target type. In a case in which there are a plurality of objects of the operation target or operation positions, the operation target type is determined for each thereof (or a combination thereof). In this case, the operation target type is defined for each of the objects of the operation target, the operation positions, or the combinations thereof.

[0035]

Moreover, for example, the operation target type determination unit 1042 may determine the operation target type according to the specification of the user. In this case, a virtual space object of a UI such as a button or a pulldown menu operated by the user is read as the operation target type of the avatar operation information 1052, and the operation target type indicated as the button or the pulldown menu is output as the operation target type information 1056.

[0036]

When the operation target type information 1056 is created in S307, the change destination candidate node

creation unit 1043 executes change destination candidate node creation processing of creating change destination candidate nodes each of which indicates a candidate of an operation position after the change of the object or the visualization frame being the operation target of the avatar operation (S308).

[0037]

FIG. 4 is a flowchart for illustrating an example of a processing procedure of the change destination candidate node creation processing. As illustrated in FIG. 4, first, the change destination candidate node creation unit 1043 of the railway operation information change system 100 reads the operation target type information 1056 and the data change rule list 1054, extracts, from the data change rule list 1054, the data change rules having the same operation target type as an "operation target type" item defined in the operation target type information 1056, and outputs the extracted data change rules as the data change rules 1058 (S401).

[0038]

The data change rule list 1054 is information which defines, in a case in which an operation is executed on each of the various types of railway operation information 1051 according to the operation target type, rules each of which relates to a data change allowed by this operation.

The data change rule list 1054 is information which defines each of the various types of the railway operation information described above, the operation target type to be executed on this railway operation information, a changeable portion which indicates an object or a visualization frame in which the change by the operation of this operation target type is allowed, and a changeable range which indicates a changeable range of this changeable portion. Moreover, the data change rule 1058 is information obtained by extracting, from the data change rule list 1054, a data change rule having the same operation target type as the "operation target type" item defined in the operation target type information 1056.

[0039]

The change destination candidate node creation unit 1043 reads the operation target type information 1056 created in S307 and the data change rules 1058 extracted in S401, and outputs the change target data information 1059 (S402). The change target data information 1059 is information for applying the data change rules 1058 to the operation target data stored in the operation target type information 1056, thereby creating the change destination candidate data ranges 1060 indicating candidates of the position after the change in the object or the visualization frame to be changed by the change operation.

The change target data information 1059 is information which defines a change target data type indicating a type of data (each piece of data in a case of a plurality of pieces of data) stored as the operation target data, change target data being operation target data indicated by this change target data type, and change target source railway operation information indicating the railway operation information 1051 including this change target data.

[0040]

For example, the change destination candidate node creation unit 1043 sets data on a "changeable portion" item of the data change rule 1058 extracted in S401 to the change target data type, and sets data which is out of data of "operation target data" item of the operation target type information and corresponds to the change target data type to the change target data. That is, the change destination candidate node creation unit 1043 extracts, as the change target data information 1059, the change target data type, the change target data, and the railway operation information 1051 to which the change target data belongs.

[0041]

Further, the change destination candidate node creation unit 1043 reads the change target data information 1059 created in S402 and the data change rules 1058

extracted in S401, and outputs the change destination candidate data ranges 1060 described above (S403). For example, the change destination candidate node creation unit 1043 assigns a value of a "change target data" item of the change target data information 1059 to data of a "changeable range" item of the data change rule 1058, calculates the change destination candidate data range of the "change target data" of the change target data information 1059, and outputs the calculated change destination candidate data range as the change destination candidate data range 1060. The change destination candidate data range 1060 is information which defines, for each piece of the change target data, identification information for identifying the change destination candidate data range and a candidate of the data range after the change of the change target data identified by this identification information.

[0042]

After that, the change destination candidate node creation unit 1043 reads the change destination candidate data ranges 1060 output in Step S403 and the railway operation information 1051 which includes all of the objects and the visualization frames displayed as the virtual space display data 1055, and outputs the change destination candidate data information 1061 (S404).

[0043]

For example, the change destination candidate node creation unit 1043 searches for and acquires values which are stored in the railway operation information 1051, and match the condition defined as the change destination candidate data range 1060, and outputs the acquired values as the change destination candidate data. At this time, the change destination candidate node creation unit 1043 considers, as the target, the railway operation information 1051 which includes all of the displayed objects and visualization frames, and creates and outputs the change destination candidate data information 1061 which associates the change destination candidate data which has been output, change destination candidate belonging destination railway operation information which indicates the railway operation information 1051 to which this change destination candidate data belongs, and a change destination candidate data type which indicates a type of this change destination candidate data.

[0044]

After that, the change destination candidate node creation unit 1043 reads the change target data information 1059 created in S402, the change destination candidate data information 1061 created in S404, and the virtual space display data 1055 created in S303, and outputs the change

destination candidate nodes 1057 (S405).

[0045]

For example, the change destination candidate node creation unit 1043 relatively calculates, for a value of a "virtual space display position" item of the virtual space display data 1055 which displays, in the virtual space, the change destination candidate belonging destination railway operation information included in the change destination candidate data information 1061, a position at which each of the pieces of change destination candidate data included in the change destination candidate data information 1061 is to be displayed. After that, the change destination candidate node creation unit 1043 updates the value of the "virtual space display position" item of the virtual space display data 1055 which includes the change destination candidate belonging destination railway operation information included in the change destination candidate data information 1061 and the object indicating the change target data being the source of the change destination target data included in the change destination candidate data information 1061 to the value of the "virtual space display position" which reflects each of the calculated relative positions. The relative position described above can be calculated as relative coordinates to the value of the "virtual space display position" before the reflection

as a reference.

[0046]

Further, the change destination candidate node creation unit 1043 creates the change destination candidate nodes 1057 each of which is formed of data which associates a virtual space object ID for identifying the object or the visualization frame which is out of the objects of this updated virtual space display data 1055 and on which the operation of the operation target type determined in S307 has been executed, an asset which indicates a display form in the virtual space of the object identified by this object ID, and a relating virtual space object ID indicating an object relating this object with one another and the change target data information 1059 and the change destination candidate data information 1061 which include object belonging destination railway operation information being the railway operation information 1051 to which this object belongs. At this time, the change destination candidate node creation unit 1043 stores, as the relating virtual space object, the virtual space object ID (object belonging destination railway operation information) which is out of the virtual space display data 1055 and indicates the railway operation information to which the object belong. When the processing in S405 is finished, there is finished the change destination candidate node creation

processing illustrated in FIG. 4.

[0047]

Returning to FIG. 3, when the change destination candidate node creation processing in S308 is finished, the display data output unit 1033 outputs the change destination candidate nodes 1057 created in this processing, and transmits the change destination candidate nodes 1057 to the user terminal 300 (S309). As a result, the railway operation information change system 100 can display the created display data on the screen.

[0048]

The avatar operation information acquisition unit 102 acquires the avatar operation information 1052 on the change destination candidate node 1057 displayed on the screen of the user terminal 300, similarly to the case in S306 (S310).

[0049]

After that, the data change reflection unit 1044 executes data change reflection processing of reflecting the acquired avatar operation information 1052 to the railway operation information 1051 (S311). With the processing in S311, it is possible to identify, out of the change destination candidate nodes 1057, a node on which the operation has been executed by the user, and to reflect an operation based on the avatar operation information 1052

on the identified node to the data on the railway operation information 1051.

[0050]

FIG. 5 is a flowchart for illustrating an example of a processing procedure of the data change reflection processing. As illustrated in FIG. 5, the data change reflection unit 1044 of the railway operation information change system 100 first reads the avatar operation information 1052 acquired in S310 and the change destination candidate nodes 1057 output in S309, and determines, out of the change destination candidate nodes 1057, the change destination node 1062 which is the node on which the operation has been executed by the user (S501).

[0051]

As specific processing for the determination described above, any method known hitherto may be used. For example, the data change reflection unit 1044 determines, for each of the change destination candidate nodes 1057, whether or not the change has occurred in the position information of the change target data included in the change target data information 1059. The data change reflection unit 1044 determines the node having the change in the position information of the change target data as the node on which the operation has been executed by the user based on the avatar operation information 1052, and

outputs the determined node as the change destination node 1062.

[0052]

After that, the data change reflection unit 1044 executes railway operation information update processing of reading the change destination node 1062 determined in S501 and the railway operation information 1051, reflecting this change destination node 1062 to the railway operation information 1051, and outputting the railway operation information 1051 after the update (S502).

[0053]

FIG. 6 is a flowchart for illustrating an example of a processing procedure of the railway operation information update processing. As illustrated in FIG. 6, the data change reflection unit 1044 of the railway operation information change system 100 first reads the change destination node 1062 which has been determined, and acquires, for this change destination node 1062, the change target belonging destination railway operation information being the railway operation information 1051 to which the change destination node 1062 output in S405 belongs and the change destination belonging destination railway operation information (S601).

[0054]

After that, the data change reflection unit 1044

reads the railway operation information 1051 matching the railway operation information 1051 to which the change destination node 1062 acquired in S601 belongs (S602).

[0055]

The data change reflection unit 1044 updates, out of the railway operation information 1051 read in S602, the values of the items of the railway operation information 1051 matching the values of the items defined as the change destination node 1062 to the values of the items defined as the change destination node 1062 (S603). At this time, in a case in which the value of the matching item does not exist (for example, in a case in which the matching item exists, but the value thereof does not exist), the data change reflection unit 1044 may add a value thereof to this item which does not have the value. As a result, the railway operation information 1051 after the update reflecting the change destination node 1062 is output.

[0056]

Further, the data change reflection unit 1044, for example, reads the railway operation information 1051 after the update, and executes predetermined simulation or the like, thereby determining whether or not the updated railway operation information 1051 satisfies various constraints provided for a case of the execution of the railway operation. In a case in which the railway

operation information 1051 does not satisfy the constraint, the data change reflection unit 1044 adjusts values of the railway operation information 1051 causing discrepancy in light of this constraint (S604). As a result, there is output the railway operation information 1051 after the update which satisfies the various constraints provided in the case of the execution of the railway operation.

[0057]

Note that, in a case in which the data change reception unit 1041 determines that the change operation request directed to the virtual space display data 1055 displayed in S304 is not received from the user terminal 300 in S305 of FIG. 3 (No in S305), the avatar operation information acquisition unit 102 acquires the avatar operation information 1052 relating to a display content change, and outputs the acquired avatar operation information 1052 to the virtual space display data determination unit 1031 (S312).

[0058]

After that, when the virtual space display data determination unit 1031 receives, from the avatar operation information acquisition unit 102, the avatar operation information 1052 relating to the display content change in S312, the virtual space display data determination unit 1031 determines the virtual space display data (S313). For

the determination, any method is used. The virtual space display data determined here is created in S303, and is output to the screen in S304.

[Second Embodiment]

[0059]

In a second embodiment, there is described a case in which the railway operation information 1051 described in the first embodiment is formed of the operation plan information and the timetable diagram. A timetable serving as a chart constituting a base is hereinafter referred to as main timetable. There is hereinafter exemplified a case in which the railway operation information is the operation plan information and the timetable diagram, but the present embodiment may similarly be applied to other various types of railway operation information.

[0060]

With reference to FIG. 7 to FIG. 11, a description is first given of display output examples in the virtual space described in the present embodiment. The railway operation information change system 100 displays, for example, in combination, a timetable for a line L1 displayed in the main timetable diagram and a timetable for a comparative line L2 which has the same departure station and arrival station, but runs in parallel as in FIG. 7. The line L1 displayed in the main timetable diagram, runs

via a station A, a station B, a station C, and a station D, and the comparative line L2 runs via the station A, a station E, a station F, and the station D. In this case, the display data output unit 1033 of the railway operation information change system 100 outputs data for displaying the main timetable diagram on a flat surface 701. As described in S312 and S313 in the first embodiment, in a case in which the user executes an operation of gripping the main timetable by both hands via an avatar 702, and pulling the main timetable, the virtual space display data determination unit 1031 of the railway operation information change system 100 determines that the timetable diagram of the comparative line as the display data, and the virtual space display data creation unit 1032 creates data for generating a curved surface 703 which crosses the flat surface 701 of the main timetable diagram on straight lines indicating the station A and the station D, and protrudes and recesses in a direction orthogonal to the flat surface 701, and displaying the timetable diagram of the comparative line on this curved surface. Note that the curved surface 703 is generated so that a travel distance or a travel time matches a length between the stations. A line T1 is an example of a timetable of a train traveling on the line L1, and a line T2 is an example of a train traveling on a line L2. This example is hereinafter

referred to as a plurality-of-timetable display example.
The line may include a vehicle depot.

[0061]

These flat surface 701 and curved surface 703, and objects displayed on these surfaces are created by the virtual space display data creation unit 1032. The virtual space display data creation unit 1032 reads the railway operation information 1051 to be displayed in the virtual space and the visualization frame 1053 matching this railway operation information 1051, and creates the virtual space display data 1055 obtained by assigning the values of the railway operation information 1051 stored in advance to the visualization frame 1053. A description is later given of specific examples of the railway operation information 1051, the visualization frame 1053, and the virtual space display data 1055.

[0062]

In FIG. 7, when a timetable diagram indicated as the curved surface 703 as certain one piece of railway operation information 1051 is displayed in the virtual space, and the avatar 702 operates a train line on the curved surface 703, each of the pieces of processing illustrated in FIG. 4 and FIG. 5 described in the first embodiment is applied to the timetable diagram being one piece of the railway operation information 1051, thereby

displaying change destination candidates of arrival and departure times of a change target train as nodes 704. In this example, four nodes are displayed, and the user moves the train line onto one node thereof to determine a final change destination node from these four nodes, thereby enabling changes in arrival and departure times of the train.

[0063]

Moreover, in FIG. 7, the object can be moved between the timetable diagrams (the line L1 on the flat surface 701 and the line L2 on the curved surface 703) being the plurality pieces of railway operation information 1051 of the same type, and a change destination of a travel section of the change target train is displayed as a node. In this example, the train which stops at the station E can be changed to a train which stops at the station B, and hence a node 705 of the station B is displayed as a node. After that, the train is moved onto this node 705 to change the train line in the travel section of the corresponding train, thereby being able to make a change from the line L2 to the comparative line L1.

[0064]

A specific description is given later, but, in the case in which the railway operation information 1051 is the timetable diagram, there are output the change destination

candidate node on the timetable diagram and, as the change destination node 1062, a node close in distance to a target which has been operated according to the avatar operation information 1052. More specifically, in a case in which the operation according to the avatar operation information 1052 moves the node via the avatar, the data change reflection unit 1044 calculates the distance between the change destination candidate node (for example, 705) on the timetable diagram and the operation target (for example, T2) on the timetable diagram. After that, in a case in which the calculated distance is equal to or longer than a predetermined threshold value, the data change reflection unit 1044 determines that the user has intentionally executed the operation on this node, and outputs the node on the timetable diagram as the change destination node 1062.

[0065]

In FIG. 7, there is exemplified a case in which the railway operation information 1051 is the timetable diagram, but the present embodiment can similarly be applied to various types of the railway operation information 1051 as described below.

[0066]

The railway operation information change system 100 displays, for example, as in FIG. 8, a line L1 displayed in

the timetable diagram (main timetable diagram) and the track information (track layout schematic diagram) on a certain station of the main timetable diagram in combination. In the case in which the line L1 displayed in the main timetable diagram runs through a station A, a station B, a station C, and a station D, the display data output unit 1033 outputs data which displays the main timetable diagram on a flat surface 801. As described in S312 and S313 in the first embodiment, in a case in which, when the user executes an operation of gripping a train stopping at the station C, and pulling this train via an avatar 802, there exist a track C1, a track C2, and a track C3 in the station C, the virtual space display data creation unit 1032 displays the track C1, the track C2, and the track C3 in parallel, from this station toward a third axis direction in the main timetable diagram, with an axis of the station C as a node 803 which indicates tracks serving as change destination candidates for the change target train. After that, the virtual space display data creation unit 1032 creates data to be displayed, through moving a train in the main timetable diagram, which travels on each track in around the time zone for this train. This example is hereinafter referred to as track information display example.

[0067]

In the example illustrated in FIG. 8, regarding the track information which is one piece of the railway operation information 1051, in order to change the track of the train which stops at the station C being the displayed station of the change target train, the track C2 which is changeable in terms of a constraint out of the tracks C1 to C3 as the change destination candidates for the track is displayed as the change destination node 804. After that, the train is moved onto this node 804, thereby being able to change the track of the corresponding train.

[0068]

Further, the railway operation information change system 100 displays, for the vehicle depot information being one of the pieces of railway operation information 1051, for example, a line L1 displayed in a timetable diagram (main timetable diagram) 901 and vehicle depot information 902 and 903 on the train operated by this line in combination, as in FIG. 9. In this example, a vehicle depot for a change target train operating on the line L1 is displayed such that the depot is changed from a node 902a indicating a vehicle depot, and a depot entry time and a depot entry track at which and on which the train enters this vehicle depot stored in vehicle depot information 902 (vehicle depot A) to a node 903a indicating a depot entry time and a depot entry track at which and on which the

train enters a vehicle depot stored in vehicle depot information 903 (vehicle depot B) being a change destination candidate for this train. After that, the virtual space display data creation unit 1032 creates data to be displayed, through moving the node 903a of the vehicle depot information relating to this train on the main timetable diagram to the node 903b of the vehicle depot information after the change. It is possible to change, by moving the train to this node 903b as indicated as M, the vehicle depot of the corresponding train and the depot entry time and the depot entry track at which and on which the train enters this vehicle depot. This example is hereinafter referred to as vehicle depot information display example.

[0069]

Further, regarding the proposed trainrailwaytrain operation adjustment rescheduling plan information being one of the pieces of railway operation information 1051, the railway operation information change system 100 displays, in combination, a timetable diagram (main timetable diagram) 1001 and a proposed trainrailwaytrain operation adjustment rescheduling plan of a train operating according to a timetable indicated by this timetable diagram 1001, as in FIG. 10, for example. In this example, a node (for example, node obtained by switching travel

sequence of trains disrupted by a delay or the like) 1002a relating to trainrailwaytrain operation adjustment of a train on a line L1 defined as a proposed trainrailwaytrain operation adjustment rescheduling plan 1002 is displayed on the timetable 1001 as a node 1002b after the change determined from among a plurality of switching candidates. After that, the virtual space display data creation unit 1032 creates data to be displayed, through moving (indicated as M) the node 1002a of this train on the proposed trainrailwaytrain operation adjustment rescheduling plan 1002 to the node 1002b after the change on the timetable 1001. It is possible to make, by moving the train to this node 1002b, a change to a timetable diagram reflecting the proposed trainrailwaytrain operation adjustment rescheduling plan of the corresponding train. This example is hereinafter referred to as proposed trainrailwaytrain operation adjustment rescheduling plan display example.

[0070]

Further, regarding the vehicle operation information being one of the pieces of railway operation information 1051, the railway operation information change system 100 displays, in combination, a timetable diagram (main timetable diagram) 1101 being a plurality of pieces of railway operation information 1051 of different types and

vehicle operation information 1102 relating to a train operated according to the timetable indicated by this timetable diagram 1101, for example, as in FIG. 11. In this example, a node (for example, the number of vehicles in formation (for example, ten)) 1102a relating to formation of a train defined as the vehicle operation information 1102 is displayed as a node 1102b which indicates the formation of the train operating on a line L1 determined from among a plurality of candidate lines on the timetable 1101. After that, the virtual space display data creation unit 1032 creates data to be displayed, through moving, which is indicated as M, the node 1102a relating to a formation of this train in the vehicle operation information 1102a to the node 1102b which indicates the formation described above on the timetable 1101. It is possible to change, by moving, to this node 1102b, the train formed according to the vehicle operation information 1102, the vehicles to be allocated to the train described in the timetable diagram, and to make a change to the timetable diagram reflecting the vehicle operation information relating to the corresponding train. This example is hereinafter referred to as vehicle operation information display example.

[0071]

As described above, the railway operation

information change system 100 displays a plurality of pieces of railway operation information in a plurality of dimensions only for the required portion operated by the user, and hence the user can intuitively and seamlessly view the required information and can intuitively change the displayed information. Note that, in these examples, there are displayed, in the three-dimensional direction, parts of the plurality of pieces of information being the change destination candidates such that these parts are superimposed on each other. With reference to FIG. 3 to FIG. 6 described in the first embodiment, a description is now given of a configuration which implements the display exemplified in FIG. 7 to FIG. 11. The user selects a desired node from among the candidate nodes indicating the change destination of the object displayed on a screen illustrated in each of FIG. 7 to FIG. 11, thereby being able to change the railway operation information intended by the user, specific processing of which is described later.

[0072]

As described in S302 of FIG. 3, the railway operation information acquisition unit 101 acquires the latest railway operation information 1051 from the railway operation system 200. A description is now given of an example of the railway operation information 1051.

[0073]

FIG 12A and FIG. 12B are tables for illustrating examples of the operation plan information being one of the pieces of railway operation information 1051. These tables illustrate the railway operation information used in the plurality-of-timetable display example of FIG. 7.

[0074]

FIG. 12A is a table for illustrating operation plan information on a train (Tr01) operating on a certain line L1. As illustrated in FIG. 12A, operation plan information 1201 stores, in association with one another, a train ID for identifying a train to be operated, a station name indicating a station which this train arrives at and departs from, and a departure time and an arrival time of this station. In FIG. 12A, there is illustrated such an operation plan that a train "Tr01" arrives at a "station A" on the line at "07:45:40," and departs at "07:46:30." Similarly, there is illustrated such an operation plan that this train departs from the "station A" at "07:46:30," and arrives at a "station B" at "07:55:50."

[0075]

FIG. 12B is a table for illustrating operation plan information on a train (Tr02) operating on another line L2. Also in operation plan information 1202 illustrated in FIG. 12B, similarly to the case of the train (Tr01) illustrated

in FIG. 12A, there is illustrated, for example, such an operation plan that the train "Tr02" departs from the "station A" at "08:00:30," and arrives at a "station E" at "08:05:20."

[0076]

FIG. 13 is a table for illustrating an example of the track information being one of the pieces of railway operation information 1051. This table illustrates the railway operation information used in the track information display example of FIG. 8, and illustrates the track information on the certain station (station C) out of stations (a station A to a station D) of the certain line L1. As illustrated in FIG. 13, track information 1301 stores, in association with one another, a station ID for identifying the certain station (station C), track IDs for identifying tracks of this station, and track names indicating the tracks identified by the track IDs. In FIG. 13, there is illustrated that the "station C" is provided with tracks "C1," "C2," and "C3."

[0077]

FIG. 14 is a table for illustrating an example of the vehicle depot information being one of the pieces of railway operation information 1501. This table illustrates the railway operation information used in the vehicle depot information display example of FIG. 9, and illustrates the

vehicle depot information relating to trains operated on certain lines L1 and L2. As illustrated in FIG. 14, vehicle depot information 1401 stores, in association with one another, a train ID for identifying a train to be operated on the line described above, a vehicle depot which this train enters and exits from, a depot entry time at which and a depot entry track on which this train arrives at this vehicle depot, and an inspection item which indicates a purpose for the depot entry of this train at the vehicle depot. In FIG. 14, for example, there is illustrated that a train identified by a train ID "Tr01" enters a vehicle depot "A" at a depot entry time "24:05:00" on a depot entry track "Pf-X1," and the purpose thereof is "train inspection" for inspecting vehicles of the train.

[0078]

FIG. 15 is a table for illustrating an example of the vehicle operation information being one of the pieces of railway operation information 1051. This table illustrates the railway operation information used in the vehicle operation information display example of FIG. 11 and illustrates the vehicle operation information on certain trains Tr01 and Tr0X. As illustrated in FIG. 15, vehicle operation information 1501 stores a train ID for identifying the train and a formation ID for identifying a vehicle formation of this train in association with each

other. In FIG. 15, for example, there is illustrated that a train identified by a train ID "Tr01" is formed according to vehicle formation identified by the formation ID "V001." In practice, in association with this formation ID, vehicle information such as types of vehicles, the number of vehicles, and the like are stored.

[0079]

An example of the trainrailwaytrain operation adjustment information illustrated in FIG. 10 includes, for example, the operation plan information (FIG. 12A and FIG. 12B) after the change in departure and arrival times for a train in which disruption has occurred due to a delay or the like, but the example of the operation plan information has already been described, and a description of the trainrailwaytrain operation adjustment information is herein omitted.

[0080]

Returning to FIG. 3, the virtual space display data creation unit 1032 uses the acquired latest railway operation information 1051 and the visualization frame 1053 stored in advance to create the virtual space display data 1055 (S303). A description is now given of a case in which there are applied the operation plan information 1201 and 1202 illustrated in FIG. 12A and FIG. 12B out of the various types of railway operation information 1051

described above and displayed through the process of S312 to S313, but various types of railway operation information 1051 described elsewhere can similarly be considered.

[0081]

FIG. 16 is a table for illustrating an example of the visualization frame 1053. In FIG. 16, there is illustrated a visualization frame 1601, out of various visualization frames 1053, matching the operation plan information including the operation plan information 1201 and 1202 described above. As illustrated in FIG. 16, the visualization frame 1601 stores, in association with one another, a virtual space object ID for identifying an object relating to the operation plan information and displayed in the virtual space, an asset which indicates a display form of the object identified by this ID in the virtual space relating to the operation plan information, a relating virtual space object ID for identifying an object relating to this object, and object data which indicates an entity of the object identified by the virtual space object ID.

[0082]

In FIG. 16, there is illustrated, for example, that an object identified by "Obj003" is an object which indicates, for a "line" object identified by "Obj001," that an object "train" identified by "Obj002" arrives at and

departs from a station, and the display form of this object is "Line." The virtual space display data creation unit 1032 may use a visualization frame which has been set in advance and that the operation plan information matches, or may determine the visualization frame from information. For example, as the items of the operation plan information 1201 and 1202 illustrated in FIG. 12A and FIG. 12B, respectively, there exist "train," "station name," "arrival time," and "departure time," and hence the virtual space display data creation unit 1032 determines that the visualization frame 1601 including these items is the visualization frame matching the operation plan information 1201 and 1202.

[0083]

When the virtual space display data creation unit 1032 determines that the visualization frame 1601 is the visualization frame matching the operation plan information 1201 and 1202, the virtual space display data creation unit 1032 assigns a value of each of the items included in the operation plan information 1201 and 1202 to the visualization frame 1601, thereby determining the display position of the object in the virtual space formed of the visualization frame 1601. In this determination, in practice, the virtual space display data creation unit 1032 refers to a coordinate position defined for each object

indicated as the object data of the visualization frame 1601, thereby determining the display position of the object in the virtual space.

[0084]

FIG. 17 is a table for illustrating an example of virtual space display data 1701 created by the virtual space display data creation unit 1032 when the operation plan information 1202 is assigned to the visualization frame 1601. As illustrated in FIG. 17, the virtual space display data 1701 stores, in association with one another, a virtual space object ID similar to the virtual space object ID of the visualization frame 1601, a display asset, a relating virtual space object ID, object data assigned to the operation plan information 1202, object belonging destination railway operation information being the railway operation information which is an assignment source of this object data, and a virtual space display position which indicates a display position of the object indicated by this object data in the virtual space.

[0085]

In FIG. 17, for example, there is illustrated that object data identified by a virtual space object ID "Obj002" is assigned as object data "train Tr02" by referring to object belonging destination railway operation information "operation plan information" (line L2)."

Moreover, there is illustrated that a display position of this object data in the virtual space is indicated as a coordinate "(0,1,0)."

[0086]

Returning to FIG. 3, when the virtual space display data 1701 is created by the virtual space display data creation unit 1032, the display data output unit 1033 transmits the created virtual space display data 1701 to the user terminal 300 in S304. As a result, the railway operation information change system 100 displays, for example, the virtual space display data 1701 relating to the plurality-of-timetable display example as illustrated in FIG. 7 on the output device such as the display of the user terminal 300.

[0087]

After that, in a case in which the data change reception unit 1041 determines that the change operation request for the virtual space display data 1701 is made from the user terminal 300 in S305 (Yes in S305), the avatar operation information acquisition unit 102 acquires the avatar operation information 1052 from the user terminal 300 (S306). The avatar operation is, as described in the first embodiment, the operation directed to the virtual space such as touching and moving each element such as an object displayed in the virtual space, and, here, a

description is given of, as an example, a case in which the user executes the avatar operation on the train line indicating the line L2 of the virtual space display data 1701 displayed on the user terminal 300.

[0088]

FIG. 18 is a table for illustrating an example of avatar operation information 1801 when the avatar operation is executed on the virtual space display data 1701. As illustrated in FIG. 18, the avatar operation information 1801 stores, in association with one another, a target virtual space object ID for identifying a target virtual space object being an object set to an operation target in the virtual space, an operation method which indicates a type of operation on this target virtual space object, and an operation position which indicates a position in the virtual space at which there has been executed the operation on this target virtual space object.

[0089]

In FIG. 18, for example, there is illustrated that an object identified by a virtual space object ID "obj003" displayed in the virtual space is acquired as the target virtual space object operated by the user. Moreover, there is illustrated that the operation on this target virtual space object is "trigger pressing," and a position of the target virtual space object after this operation in the

virtual space is "(5.1, 1.25, 0.3)."

[0090]

Returning to FIG. 3, when the avatar operation information 1801 is acquired, the operation target type determination unit 1042, in S307, determines the operation target type indicating on which object or visualization frame included in the virtual space display data 1701 the operation included in this avatar operation information 1801 has been executed, and creates operation target type information 1901 including the determined operation target type.

[0091]

FIG. 19 is a table for illustrating an example of the operation target type information 1901. As illustrated in FIG. 19, the operation target type information 1901 stores, in association with one another, the operation target type described above, the operation target data which is the data for displaying the visualization frame or the object of this operation target type, and operation target belonging destination railway operation information indicating the operation plan information 1201 and 1202 being the railway operation information 1051 including this operation target data.

[0092]

In FIG. 19, for example, there is illustrated that

the operation target type determination unit 1042 determines that the type of the object on which the avatar operation has been executed according to the avatar operation information 1801 is an object "train (station departure - station arrival)" identified by the virtual space object ID "Obj003." As the method for this determination, as described in the first embodiment, there are the automatic determination method based on the object of the operation target or the operation position included in the avatar operation information 1801 and the determination method based on the specification by the user.

[0093]

Moreover, there is illustrated that, as the entity of the object of the determined type, an object data "line L2, train Tr02, departure from station A at 08:00:30 arrival at station E at 08:05:20" is the operation target data. This object data can be acquired from the object data of the virtual space display data 1701 by using the virtual space object ID "Obj003" as a key. Further, there is illustrated that the object belonging destination railway operation information which is the source of the assignment of the object data is "operation plan information (line L2)." This object belonging destination railway operation information can be acquired from the

object belonging destination railway operation information of the virtual space display data 1701.

[0094]

Returning to FIG. 3, when the operation target type information 1901 is created, the change destination candidate node creation unit 1043 executes, in S308, the change destination candidate node creation processing of creating the change destination candidate nodes each of which indicates the candidate of the operation position after the change of the object or the visualization frame being the operation target.

[0095]

For example, in S401 of FIG. 4, the change destination candidate node creation unit 1043 extracts, from a data change rule list 2001, a data change rule having the same operation target type as the operation target type "train (station departure - station arrival)" defined in the operation target type information 1901, and outputs the extracted data change rule as a data change rule 2101.

[0096]

FIG. 20 is a diagram for illustrating an example of the data change rule list 2001. As described in the first embodiment, the data change rule list 2001 is stored in advance in the present system. The data change rule list

2001 is the information which defines, in the case in which the operation is executed according to the operation target type on the various types of railway operation information 1051 including the operation plan information 1201 and 1202, the rules each of which relates to the data change allowed by this operation. As illustrated in FIG. 20, the data change rule list 2001 stores, in association with one another, each of the various types of railway operation information described above, the operation target type executed on this railway operation information, the changeable portion which indicates the object or the visualization frame that the change by the operation of this operation target type is allowed, and the changeable range which indicates the changeable range for this changeable portion.

[0097]

In FIG. 20, for example, there is illustrated that, in a case in which the target railway operation information is "operation plan information," and an operation indicated by an operation target type "train (station arrival - station departure)," "train (station departure - station arrival)," and "train (arrival station)" is executed on this "operation plan information," the changeable portion allowed for the object or the visualization frame in the virtual space is "arrival time of arrival station."

Moreover, there is illustrated that the changeable range of this changeable portion "arrival time of arrival station" is "within ± 300 seconds of arrival time, every 10 seconds." Moreover, there is illustrated that, in a case in which the target railway operation information is "track information," and an operation indicated by an operation target type "train (all)" and "train (station arrival - station departure)" is executed on this "track information," the changeable portion allowed for the object or the visualization frame in the virtual space is "track," and its changeable range is "in case of presence of changeable track."

[0098]

A lower row of FIG. 20 illustrates an example of the operation target type. A description is now given of, as an example, a case in which the user executes the avatar operation on the train line. In the case in which the user executes the avatar operation on the "operation plan information" being one of the pieces of railway operation information 1051, as described above, there are (1) the operation indicated by the operation target type "train (station departure - station arrival)," (2) the operation indicated by the operation target type "train (station arrival - station departure)," and (3) the operation indicated by the operation target type "train (arrival

station)." In the lower row of FIG. 20, the train line is expressed while a vertical axis is set to a stations sequence, and a horizontal axis is set to time. In this diagram, the operation of (1) is an operation on a train line from departure of a train from a station to arrival at a next station, and is, for example, an operation on a train line 2002A between a station A and a station B. Moreover, the operation of (2) is an operation on a train line from arrival at a station to departure from the station, and is, for example, an operation on a train line 2002B between arrival at a station C and departure from the station C. Moreover, the operation of (3) is an operation on a train line at the time of arrival of a train at a station, and is, for example, an operation on a train line 2002C at the time of arrival at the station C. In addition thereto, there is an operation on a train line at the time of departure of a train from a station (for example, an operation on a train line 2003A at the time of the departure from the station C). Further, there is also an operation on a whole train line (for example, an operation on a whole train line 2005A from the station A to a station D).

[0099]

As described above, there are various operation target types as the types of avatar operation on the

various types of railway operation information 1051, and hence the change destination candidate node creation unit 1043 extracts at least records including the same operation target type as the operation target type "train (station departure - station arrival)" defined in the operation target type information 1901 from the data change rule list 2001, and outputs, the extracted records, as data change rules 2101. In this example, records 2002, 2003, and 2004 included in the data change rule list 2001 are output as the data change rules 2101.

[0100]

FIG. 21 is a table for illustrating an example of the data change rules 2101. The data change rule 2101 is information obtained by extracting, from the data change rule list 2001, the data change rule having the same operation target type as the "operation target type" defined in the operation target type information 1901. As described above, it is apparent that the records 2002, 2003, and 2004 are extracted, in FIG. 21. Items of the data change rule 2101 are similar to those of the data change rule list 2001, and a description thereof is herein omitted.

[0101]

Returning to FIG. 4, the change destination candidate node creation unit 1043 reads, in S402, the

operation target type information 1901 created in S307 and the data change rules 2101 extracted in S401, and outputs change target data information 2201.

[0102]

FIG. 22 is a table for illustrating an example of change target data information 2201. The change target data information 2201 is information for applying the data change rules 2101 to the operation target data stored in the operation target type information 1901, thereby creating change destination candidate data ranges 2201. The change destination candidate data range 2201 is information which indicates candidates of a position after the change of the object or the visualization frame to be changed through the avatar operation.

[0103]

As illustrated in FIG. 22, the change target data information 2201 is information which defines a change target data type indicating a type of data stored as the operation target data, change target data which is operation target data indicated by this change target data type, and change target belonging destination railway operation information which indicates the railway operation information 1051 including this change target data.

[0104]

In FIG. 22, for example, each of "departure from

station A at 08:00:30," "arrival at station E at 08:05:20," and "station A - station E" being the operation target data corresponding to the operation target type "train (station departure - station arrival)" of the operation target type information 1901 is acquired as the change target data of the change target data information 2201. The change destination candidate node creation unit 1043 acquires, as the change target data type of the change target data information 2201, the changeable portion corresponding to the record including the operation target type "train (station departure - station arrival)" described above out of the data change rules 2101, for each of these pieces of change target data, further acquires, as the change target belonging destination railway operation information of the change target data information 2201, the operation target belonging destination railway operation information "operation plan information (line L2)" corresponding to the operation target type "train (station departure - station arrival)" of the operation target type information 1901, and outputs, as the change target data information 2201, them in association with each other.

[0105]

More specifically, the change destination candidate node creation unit 1043 identifies the record 2103 including the changeable portion corresponding to

"departure from station A at 08:00:30" being the operation target data of the operation target type information 1901 out of the records 2101, 2102, and 2103 including the operation target type "train (station departure - station arrival)" out of the data change rules 2101. This method for the identification is only required to be implemented on the basis of, for example, whether or not the record includes the changeable portion (in this case, "departure time from departure station") containing the same concept or meaning as that of the operation target data "departure from station A at 08:00:30." After that, the change destination candidate node creation unit 1043 associates the identified changeable portion of the record with the change target data "departure from station A at 08:00:30" and the operation target belonging destination railway operation information "operation plan information (line L2)," and outputs as a record 2202 of the change target data information 2201.

[0106]

Similarly, the change destination candidate node creation unit 1043 identifies, for all of the other pieces of data "arrival at station E at 08:05:20" and "station A - station E" stored as the operation target data of the operation target type information 1901, the record 2102 and 2104 including changeable portions corresponding thereto,

respectively, and, then, outputs them as the records 2203 and 2204 of the change target data information 2201. The change target data type "travel section" of the record 2204 is the changeable portion "travel section" of the data change rule 2101, "line L2" indicating the travel section of the train "Tr02" as the operation target data of the operation target type information 1901, and hence the change destination candidate node creation unit 1043 can acquire the record on the basis of this information. As described above, with the processing in S402, the change destination candidate node creation unit 1043 refers to the operation target data of the operation target type information 1901 and the changeable portion of the change target data information 2201, thereby determining the change target data and the change target data type of the change target data information 2201.

[0107]

Returning to FIG. 4, in S403, the change destination candidate node creation unit 1043 reads the change target data information 2201 created in S402 and the data change rules 2101 extracted in S401, and outputs the change destination candidate data ranges 2301.

[0108]

FIG. 23 is a table for illustrating an example of the change destination candidate data ranges 2301. The

change destination candidate data range 2301 stores, for each piece of the change target data stored in the change target data information 2201, a range ID for identifying the change destination candidate data range and a change destination candidate data range which is identified by this range ID and indicates a candidate of the data range after the change in the change target data in association with each other.

[0109]

In the example of FIG. 23, there is stored a change destination candidate data range "station A, range of 07:55:30 - 08:05:30, every 10 seconds" identified by a range ID "Rn01." For example, the change destination candidate node creation unit 1043 reads the change target data type "departure time from departure station" corresponding to the change target data "departure from station A at 08:00:30" of the change target data information 2201. Further, the change destination candidate node creation unit 1043 reads the changeable range "within ± 300 seconds of arrival time, every 10 seconds" stored in association with the changeable portion of the data change rule 2101 including this change target data type "departure time from departure station." After that, the change destination candidate node creation unit 1043 calculates, through application of the rule of the

changeable range "within ± 300 seconds of arrival time, every 10 seconds," the range of the change destination candidate of the change target data "departure from station A at 08:00:30," that is, the range of the value of this change target data to be possibly changed. As a result, as the change destination candidate data range corresponding to the range ID "Rn01," "station A, range of 07:55:30 - 08:05:30, every 10 seconds" is output. For all of the other pieces of change target data, the change destination candidate data ranges are similarly calculated, and the change destination candidate data 2301 is output. As described above, the change destination candidate node creation unit 1043 creates the change destination candidate data range 2301 having the specific value from the change target data of the change target data information 2201 and the changeable range of the data change rule 2101.

[0110]

After that, in S404, the change destination candidate node creation unit 1043 reads, in order to create the change destination candidate nodes, the change destination candidate data ranges 2301 output in S403 and the railway operation information 1051 (in this example, the operation plan information 1201 and 1202) including all of the objects and the visualization frames displayed as the virtual space display data 1701 illustrated in FIG. 17,

examines a relationship of each of all of the pieces of read railway operation information 1051 with each of the change destination candidate data ranges, and outputs the change destination candidate data information 2401.

[0111]

FIG. 24 is a table for illustrating an example of the change destination candidate data information 2401. As illustrated in FIG. 24, the change destination candidate data information 2401 stores, in association with one another, change destination candidate data indicating a value included in the change destination candidate data range 2301, a change target data type corresponding to this change destination candidate data, and change destination candidate belonging destination railway operation information being the railway operation information 1051 including this change destination candidate data.

[0112]

In FIG. 24, for example, there is illustrated that the change destination candidate data type of change destination candidate data "departure from station A at 07:55:30" being one of the values included in the change destination candidate data range 2301 is "departure time from departure station" similar to the change target data information 2201, and the railway operation information including this change destination candidate data is

"operation plan information (line L2)." The change destination candidate node creation unit 1043 calculates values each matching the condition defined as the change destination candidate data range 1060, and outputs each of the calculated values as the change destination candidate data. The change destination candidate node creation unit 1043 reads, for each of the pieces of change destination candidate data having the output values, the change target data type of the change target data information 2201 being the creation source of the change destination candidate data range 2301, and outputs the read change target data type as the change destination candidate data type. Further, the change destination candidate node creation unit 1403 outputs the railway operation information 1501 (either one or both of the operation plan information 1201 and 1202) including these pieces of change destination candidate data as the change destination candidate belonging destination railway operation information. As described above, the change destination candidate node creation unit 1043 takes out the data included in the railway operation information 1051 (in this example, the operation plan information 1201 and 1202) which exists in the change destination candidate data ranges 2301 and is displayed as the virtual space display data 1701, and outputs, as the change destination candidate data

information 2401, the data which has been taken out.

[0113]

Returning to FIG. 4, in S405, the change destination candidate node creation unit 1043 reads the change target data information 2201 created in S402, the change destination candidate data information 2401 created in S404, and the virtual space display data 1701 created in S303, and outputs change destination candidate nodes 2501. At this time, as described in the first embodiment, the change destination candidate node creation unit 1043 relatively calculates the position at which each of the pieces of change destination candidate data included in the change destination candidate data information 2401, for the value of the "virtual space display position" item of the virtual space display data 1701 which displays, in the virtual space, the change destination candidate belonging destination railway operation information included in the change destination candidate data information 2401. After that, the change destination candidate node creation unit 1043 updates, to values reflecting the calculated relative positions, the values of the "virtual space display position" item of the virtual space display data 1701 which includes the change destination candidate belonging destination railway operation information of the change destination candidate data information 2401 and the object

indicating the change target data being the source of the change destination target data included in the change destination candidate data information 2401.

[0114]

FIG. 25 is a table for illustrating an example of the change destination candidate nodes 2501. The change destination candidate node 2501 is data which associates, with one another, the change target data information 2201, the change destination candidate data information 2401 obtained from this change target data information 2201, and the virtual space display data 1701 which displays these pieces of information, and is information which indicates the candidates of the operation position after the change in object or visualization frame when the avatar operation indicated by the avatar operation information 1801 is executed. As illustrated in FIG. 25, the change destination candidate node 2501 stores, in association with one another, the change target data 2201, the change destination candidate data 2401 calculated for each of the pieces of change target data 2201 in the change destination candidate data ranges 2301, and the virtual space display data 1701 (a part of items thereof in this example) relating to the change target belonging destination railway operation information of the change target data 2201 or the change destination candidate belonging destination railway

operation information of the change destination candidate data 2401.

[0115]

In FIG. 25, for example, for a record 2502 on the first row, there are stored, in association with one another, the change target data similar to the record 2202 of the change target data 2201, change destination candidate data similar to record 2402 of the change destination candidate data 2401, and the virtual space display data 1702 including the railway operation information "operation plan information (line L2)" included in these pieces of data and an object or a visualization frame displayed in the virtual space corresponding to this railway operation information. Each of these items are described in FIG. 17, and FIG. 22 to FIG. 24, and hence a description thereof is herein omitted. When the processing in S405 is finished, the change destination candidate node creation processing illustrated in FIG. 4 is finished, and the display data output unit 1033 proceeds to the processing in S309 illustrated in FIG. 3.

[0116]

In S309, the display data output unit 1033 outputs the change destination candidate nodes 2501 created in this processing, and transmits the change destination candidate nodes 2501 to the user terminal 300. As a result, the

railway operation information change system 100 displays the created display data on the screen. The change destination candidate nodes 2501 are displayed on the screen of the user terminal 300 as display data, for example, the virtual space illustrated as the plurality-of-timetable display example illustrated in FIG. 7. In the example of FIG. 7, it is apparent that the change destination candidate nodes 2501 (including four nodes 704 in this example) created in the change destination candidate node creation processing of FIG. 4 is displayed.

[0117]

After that, in Step S310, the avatar operation information acquisition unit 102 acquires, similarly to the case in S306, the avatar operation information 1801 for the change destination candidate nodes 2501 displayed on the screen of the user terminal 300. That is, the avatar operation information acquisition unit 102 acquires the avatar operation on the node on which the user actually makes a change out of the change destination candidate nodes 2501. In this example, there is acquired the avatar operation actually executed on the train line indicating the line L2 out of the candidates (four nodes 704).

[0118]

After that, in S311, the data change reflection unit 1044 executes the data change reflection processing of

reflecting the acquired avatar operation information 1801 to the railway operation information 1051 (the operation plan information 1201 and 1202 in this example).

[0119]

For example, in S501 of FIG. 5, the data change reflection unit 1044 reads the avatar operation information 1801 acquired in S310 and the change destination candidate nodes 2501 output in S309, and determines, from among the change destination candidate nodes 2501, the change destination node 2601 on which the avatar operation has actually been executed. In FIG. 7, for example, there is illustrated that, out of the four nodes 704 and the one node 705, through the avatar operation executed on the basis of the avatar operation information 1801, the node 704 on a lower left side of the diagram is determined as the change destination node 2601. As the method for this determination, the method described in the first embodiment is only required to be used.

[0120]

FIG. 26 is a table for illustrating an example of the change destination node 2601. As illustrated in FIG. 26, the change destination node 2601 stores the items relating to the change destination node determined from among the change destination candidate nodes 2501, which items are similar to those of the change destination

candidate nodes 2501. The items of the change destination node 2601 are similar to those of each of the change destination candidate nodes 2501, and hence a description thereof is herein omitted. As described above, the data change reflection unit 1044 outputs, out of the change destination candidate nodes to be possibly changed through this avatar operation information 1801, a node corresponding to the avatar operation information 1801 as the change destination node.

[0121]

In S502, the data change reflection unit 1044 executes railway operation information update processing of reflecting the change destination node 2601 determined in S501 to the various types of railway operation information 1051 including the operation plan information 1201 and 1202, and outputting the railway operation information 1051 after the update.

[0122]

Specifically, the data change reflection unit 1044 reads the determined change destination node 2601 in S601, and acquires, for this change destination node 2601, the change target belonging destination railway operation information and the change destination belonging destination railway operation information stored in the change destination node 2601 output in S405. In this

example, for either one of the change target belonging destination railway operation information and the change destination belonging destination railway operation information, there is acquired "line operation information (line L2)."

[0123]

After that, the data change reflection unit 1044 reads, in S602, railway operation information 1051 matching the change target belonging destination railway operation information "line operation information (line L2)" (that is, the railway operation information to which the node which has actually been the target of the avatar operation belongs) of the change destination node 2601 acquired in S601.

[0124]

Further, the data change reflection unit 1044 updates, in S603, the item of the railway operation information 1051 including the value matching the change target belonging destination railway operation information "line operation information (line L2)" of the change destination node 2601 out of the railway operation information 1051 read in S602 to the change destination belonging destination railway operation information of the change destination node 2601. For example, in a case in which the change destination belonging destination railway

operation information of the change destination node 2601 is changed to "line operation information (line L1)" or the like, the data change reflection unit 1044 updates, to this "line operation information (line L1)" or the like, the item of the railway operation information 1051 including the matching value included in another piece of railway operation information 1051. As a result, it is possible to reflect the change destination node 2601 on which the avatar operation has actually been executed to another piece of railway operation information 1051.

[0125]

After that, the data change reflection unit 1044 reads, in S604, the railway operation information 1051 after the reflection, executes, for example, predetermined simulation, and adjusts, in a case in which various constraints in a case of the execution of the railway operation are not satisfied, the values of the railway operation information 1051 such that the constraints are satisfied. As a result, there is output the railway operation information 1051 after the update which satisfies the various constraints provided in the case of the execution of the railway operation.

[0126]

With the above embodiments, the railway operation information change system 100 can change and display

various types of railway information according to the operation by the user. Note that the embodiments are merely an example, and, in practice, only required display output example is used, or new display output example is created and then used.

[0127]

In the above embodiment, as described with reference to FIG. 3 to FIG. 6 and the like, in the railway operation information change system (for example, the railway operation information change system 100) that changes the information relating to the railway operation displayed by the computer including the processor and the memory in the virtual space, the processor: acquires the information (for example, the avatar operation information 1052 and the operation target type information 1056) relating to the change operation made to the operation via the avatar displayed in the virtual space for the virtual space display data (for example, the virtual space display data 1055) created on the basis of the information (for example, the railway operation information 1051) relating to the railway operation and the visualization rule that defines the visualization rule (for example, the visualization frame 1053) for the data in order to display the data in the virtual space, and stores the acquired information in the memory (the avatar operation information acquisition

unit 102 and the data change reception unit 1041); determines the type of the change operation on the basis of the acquired information relating to the change operation (operation target type determination unit 1042); creates the candidate nodes (for example, the change destination candidate node 1057) that serve as the change destinations of the change operation made to the virtual space display data, on the basis of the determined type and the data change rule (for example, the data change rule list 1054) that indicates the rule for the change operation according to the type and the information relating to the railway operation defined in advance, and stores the created candidate nodes in the memory (change destination candidate node creation unit 1043); determines, on the basis of the operation on the created candidate node via the avatar, the node on which the change operation has been made out of the created candidate nodes; and updates the information relating to the railway operation that includes the node that satisfies the predetermined condition (for example, the various constraints provided in the case of the execution of the railway operation) for the determined node (for example, the change destination node 1062) (data change reflection unit 1044).

[0128]

That is, in the railway operation information change

system 100, the virtual space is used, and the user can change the displayed various types of railway operation information via the avatar. Specifically, in the case in which the user operates the object displayed in the virtual space via the avatar, the candidate values which can change the object of the operation target are displayed in the virtual space as the change destination candidate nodes. After that, when the user makes a change of one of the displayed nodes through the movement of the object or the like, the value of the node of the object of the operation target is updated to the value of the node after the movement. As already describe, the change destination candidate node is created through use of the data change rule prepared in advance and the information such as the operation target type. After that, the change made by the user is reflected to the railway operation information to which the data of the operation target forming the node changed by the user out of the change destination candidate nodes belongs, and is reflected to the railway operation information including the data of this operation target.

[0129]

Thus, it is possible for the user to intuitively understand the plurality of pieces of displayed railway operation information, and to access the plurality of pieces of railway operation information through a unified

interface, thereby changing the data. Moreover, as described in the second embodiment, the present system can be applied to the various types of railway operation information, as in the plurality-of-timetable display example (FIG. 7), the track information display example (FIG. 8), the vehicle depot information display example (FIG. 9), the trainrailwaytrain operation adjustment information (FIG. 10), and the vehicle operation information display example (FIG. 11), as the plurality of pieces of railway operation information, thereby being able to intuitively make the change by the user, and to reflect this change through a unified interface. As a result, the user can change the data on the various types of railway operation information effectively in an energy saving manner without operating a plurality of systems and computers, and thus an environmentally friendly system can be provided.

[0130]

As described with reference to FIG. 1, FIG. 2, and the like, the railway operation information change system may be included in the railway operation information management system formed by connecting, to one another via the network (for example, the networks N1 and N2), the railway operation information change system that is formed of the computer including the processor and the memory and

changes the information relating to the railway operation displayed in the virtual space, the railway operation system (for example, the railway operation system 200) that holds the information relating to the railway operation, and the user terminal (for example, the user terminal 300) that is operated by the user. In this case, the railway operation information change system: acquires the information relating to the railway operation from the railway operation system via the network (railway operation information acquisition unit 101); acquires, from the user terminal, the information (for example, the avatar operation information 1052 and the operation target type information 1056) relating to the change operation made to the operation via the avatar displayed in the virtual space for the virtual space display data (for example, the virtual space display data 1055) created on the basis of the acquired information relating to the railway operation and the visualization rule (for example, the visualization frame 1053) that defines the visualization rule for data in order to display the data in the virtual space (avatar operation information acquisition unit 102 and data change reception unit 1041); determines the type of the change operation on the basis of the acquired information relating to the change operation (operation target type determination unit 1042); creates the candidate nodes (for

example, the change destination candidate node 1057) that serve as the change destinations of the change operation made to the virtual space display data, on the basis of the determined type and the data change rule (for example, the data change rule list 1054) that indicates the rule for the change operation according to the type and the information relating to the railway operation defined in advance (change destination candidate node creation unit 1043); determines, on the basis of the operation on the created candidate node via the avatar from the user terminal, the node on which the change operation has been made out of the created candidate nodes; and updates the information relating to the railway operation that includes the node that satisfies the predetermined condition (for example, the various constraints provided to the case of the execution of the railway operation) for the determined node (for example, the change destination node 1062) (data change reflection unit 1044). With this configuration, as with the railway operation information change system, it is possible to support the user in the intuitive understanding of the plurality of pieces of railway operation information and the unitary data change for the plurality of pieces of railway operation information.

[0131]

Moreover, as described with reference to FIG. 7 to

FIG. 11, FIG. 12A, FIG. 12B, and the like, the processor uses at least one of pieces of information relating to the railway operation including the operation plan information that indicates the operation plan for the train, the track information relating to the departure and arrival of the train, the vehicle depot information relating to the train, the vehicle operation information that allocates the vehicle to be used to the operation plan, the timetable diagram that indicates the operation plan, and the proposed trainrailwaytrain operation adjustment rescheduling plan information that is obtained by changing the operation plan, to acquire the change operation, to create the candidate nodes, and to update the information relating to the railway operation. As a result, the user can intuitively understand the information relating to these various types of railway operation, and can change the data for the plurality of pieces of railway operation information through a unified interface.

[0132]

Moreover, as described with reference to FIG. 19 and the like, the processor outputs, in the determination, the operation target type information that associates the type, the operation target data that has been the target of the change operation, and the information relating to the railway operation including this operation target data with

one another, and creates the candidate nodes on the basis of the output operation target type information and the data change rule. As a result, it is possible to create the candidate node conforming to the rule defined in advance according to the type of the avatar operation by the user.

[0133]

Moreover, as described in S403 and with reference to FIG. 20 to FIG. 22 and the like, the data change rule includes the changeable range of the change operation relating to the type, and the processor creates, on the basis of the type and the changeable range of the data change rule, the change destination candidate data range (for example, the change destination candidate data range 1060) that indicates the range of the candidate nodes being the change destinations in the creation of the candidate nodes. As a result, it is possible to determine, according to the type of the avatar operation by the user, the range of the candidate nodes to be displayed.

[0134]

Moreover, as described in S404 and with reference to FIG. 23, FIG. 24, and the like, the processor examines the relationship to the change destination candidate data range for all of pieces of information relating to the railway operation displayed as the virtual space display data. As

a result, for the railway operation information 1051 (for example, the operation plan information 1201 and 1202) including all of the displayed objects and visualization frames, it is possible to determine the range of the candidate nodes.

[0135]

Moreover, as described with reference to FIG. 25 and the like, the processor: outputs, in the determination, the operation target type information that associates the type, the operation target data that has been the target of the change operation, and the information relating to the railway operation including this operation target data with one another; and outputs, as the candidate nodes, the data (for example, the change destination candidate nodes 2501) including at least the change target data that is stored as the operation target data for applying the data change rule to the operation target data stored in the operation target type information to create the change destination candidate data range, a type of this change target data, the change target belonging destination railway operation information that is information relating to the railway operation to which this change target data belongs, the change destination candidate data that is calculated, through the change destination candidate data range, for each piece of data of the change target data, the type of this change

destination candidate data, and the change destination candidate belonging destination railway operation information being the information relating to the railway operation to which the change destination candidate data belongs. As a result, for example, it is possible to output, as the candidate node, the data which associates the change target data information 1059, the change destination candidate data information 1061, and the virtual space display data 1055 with one another.

[0136]

Moreover, as described with reference to FIG. 6 and the like, the processor updates, in the update of the information relating to the railway operation, for the information relating to the railway operation including the change target belonging destination railway operation information (for example, the change target belonging destination railway operation information "line operation information (line L2)" of FIG. 26) relating to the determined node, both of this change target belonging destination railway operation information and the change destination candidate belonging destination railway operation information (for example, the change destination candidate belonging destination railway operation information "line operation information (line L2)" of FIG. 26). In this example, either one of the change target

belonging destination railway operation information and the change destination belonging destination railway operation information is "line operation information (line L2)," but, in the record 2504 illustrated in FIG. 25, the change target belonging destination railway operation information is stored as "line operation information (line L2)," and the change destination belonging destination railway operation information is stored as "line operation information (line L1)." Thus, in a case in which this record is determined as the change destination node, for the information relating to the other various types of railway operation including this change target belonging destination railway operation information "line operation information (line L2)," in addition to this change target belonging destination railway operation information "line operation information (line L2)," the change destination candidate belonging destination railway operation information "line operation information (line L1)" is also to be updated. As a result, even in a case in which the change target belonging destination railway operation information is updated to the change destination candidate belonging destination railway operation information, the content thereof can be reflected to the information relating to other various types of railway operation.

[0137]

The present invention has been described in details with reference to the drawings, but is not limited to the various examples described above, and can be changed in various ways within a scope not departing from the purport thereof.

Reference Signs List

[0138]

- 100: Railway operation information change system
- 101: Railway operation information acquisition unit
- 102: Avatar operation information acquisition unit
- 103: Data display control unit
- 1031: Virtual space display data determination unit
- 1032: Virtual space display data creation unit
- 1033: Display data output unit
- 104: Data change unit
- 1041: Data change reception unit
- 1042: Operation target type determination unit
- 1043: Change destination candidate node creation unit
- 1044: Data change reflection unit
- 105: Data storage unit
- 1051: Railway operation information
- 1052: Avatar operation information
- 1053: Visualization frame
- 1054: Data change rule list

1055: Virtual space display data
1056: Operation target type information
1057: Change destination candidate node
1058: Data change rule
1059: Change target data information
1060: Change destination candidate data range
1061: Change destination candidate data information
1062: Change destination node
200: Railway operation system
300: User terminal
N1, N2: Network

CLAIMS

[Claim 1]

A railway operation information change system that changes information relating to railway operation displayed in a virtual space, by a computer including a processor and a memory, wherein

the processor

acquires information relating to a change operation made to an operation via an avatar displayed in the virtual space, for virtual space display data created on a basis of the information relating to the railway operation and a visualization rule that defines a visualization rule for data in order to display the data in the virtual space, and stores the acquired information in the memory,

determines a type of the change operation on a basis of the acquired information relating to the change operation,

creates candidate nodes that serve as change destinations of the change operation made to the virtual space display data, on a basis of the determined type and a data change rule that indicates a rule for the change operation according to the type and the information relating to the railway operation defined in advance, and stores the created candidate nodes in the memory, and

determines, on a basis of an operation on the created candidate node via the avatar, a node on which the change operation has been made out of the created candidate nodes, and updates the information relating to the railway operation that includes a node that satisfies a predetermined condition for the determined node.

[Claim 2]

The railway operation information change system according to claim 1, wherein

the processor

uses at least one of pieces of the information relating to the railway operation including operation plan information that indicates an operation plan for a train, track information relating to departure and arrival of the train, vehicle depot information relating to the train, vehicle operation information that allocates a vehicle to be used to the operation plan, a timetable diagram that indicates the operation plan, and proposed trainrailwaytrain operation adjustment rescheduling plan information that is obtained by changing the operation plan, to acquire the change operation, to create the candidate nodes, and to update the information relating to the railway operation.

[Claim 3]

The railway operation information change system

according to claim 1, wherein

the processor

outputs, in the determination, operation target type information that associates the type, operation target data that has been a target of the change operation, and the information relating to the railway operation including this operation target data with one another, and

creates the candidate nodes on a basis of the output operation target type information and the data change rule.

[Claim 4]

The railway operation information change system according to claim 1, wherein

the data change rule includes a changeable range of the change operation relating to the type, and

the processor

creates, on a basis of the type and the changeable range of the data change rule, a change destination candidate data range that indicates a range of the candidate nodes being the change destinations in the creation of the candidate nodes.

[Claim 5]

The railway operation information change system according to claim 4, wherein

the processor

examines a relationship to the change destination

candidate data range for all of pieces of information relating to the railway operation displayed as the virtual space display data.

[Claim 6]

The railway operation information change system according to claim 4, wherein

the processor

outputs, in the determination, operation target type information that associates the type, operation target data that has been a target of the change operation, and the information relating to the railway operation including this operation target data with one another, and

outputs, as the candidate nodes, data including at least change target data that is stored as the operation target data for applying the data change rule to the operation target data stored in the operation target type information to create the change destination candidate data range, a type of this change target data, change target belonging destination railway operation information that is information relating to the railway operation to which this change target data belongs, change destination candidate data that is calculated, through the change destination candidate data range, for each piece of data of the change target data, a type of this change destination candidate data, and change destination candidate belonging

destination railway operation information being the information relating to the railway operation to which the change destination candidate data belongs.

[Claim 7]

The railway operation information change system according to claim 6, wherein

the processor

updates, in the update of the information relating to the railway operation, for the information relating to the railway operation including the change target belonging destination railway operation information relating to the determined node, both of this change target belonging destination railway operation information and the change destination candidate belonging destination railway operation information.

[Claim 8]

A railway operation information management system formed by connecting, to one another via a network, a railway operation information change system that is formed of a computer including a processor and a memory and that changes information relating to railway operation displayed in a virtual space, a railway operation system that holds the information relating to the railway operation, and a user terminal that is operated by a user, wherein

the railway operation information change system

acquires the information relating to the railway operation from the railway operation system via the network,

acquires, from the user terminal, information relating to a change operation made to an operation via an avatar displayed in the virtual space, for virtual space display data created on a basis of the acquired information relating to the railway operation and a visualization rule that defines a visualization rule for data in order to display the data in the virtual space,

determines a type of the change operation on a basis of the acquired information relating to the change operation,

creates candidate nodes that serve as change destinations of the change operation made to the virtual space display data, on a basis of the determined type and a data change rule that indicates a rule for the change operation according to the type and the information relating to the railway operation defined in advance, and

determines, on a basis of an operation on the created candidate node via the avatar from the user terminal, a node on which the change operation has been made out of the created candidate nodes, and updates the information relating to the railway operation that includes a node that satisfies a predetermined condition for the

determined node.

[Claim 9]

A railway operation information change method of changing information relating to railway operation displayed in a virtual space, by a computer including a processor and a memory, wherein

the computer

acquires information relating to a change operation made to an operation via an avatar displayed in the virtual space, for virtual space display data created on a basis of the information relating to the railway operation and a visualization rule that defines a visualization rule for data in order to display the data in the virtual space,

determines a type of the change operation on a basis of the acquired information relating to the change operation,

creates candidate nodes that serve as change destinations of the change operation made to the virtual space display data, on a basis of the determined type and a data change rule that indicates a rule for the change operation according to the type and the information relating to the railway operation defined in advance, and

determines, on a basis of an operation on the created candidate node via the avatar, a node on which the change operation has been made out of the created candidate

nodes, and updates the information relating to the railway operation that includes a node that satisfies a predetermined condition for the determined node.