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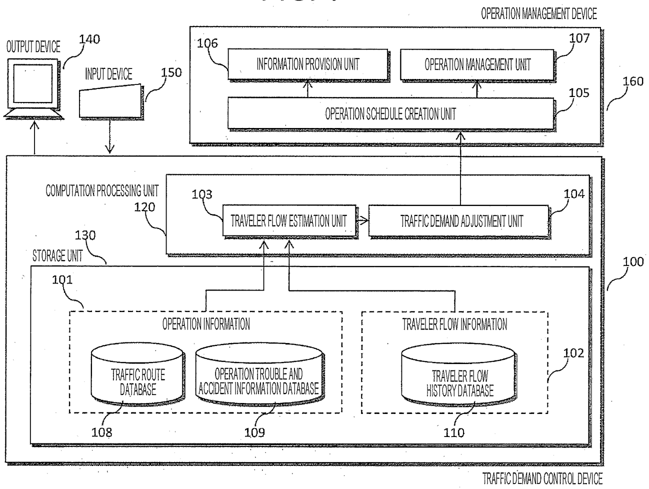
(54) ## TRAFFIC DEMAND CONTROL DEVICE

(57) Provided is a traffic demand control device that provides control information such that each traffic means has a desired usage rate in a traffic network in which a plurality of traffic means exist. In order to solve the above object, the traffic demand control device includes: a storage unit that stores operation situation data indicating the past operation situation, a traveler flow history indicating a usage history of a traffic means of a traveler, and a control variable functioning as a determination criterion when the traveler selects the transport; and a computation processing unit that obtains a usage probability of the traveler for each traffic means in association with a departure place or a destination place, from the operation situation data and the traveler flow history that are stored in the storage unit. The computation processing unit obtains the control variable such that the usage probability of each traffic means in a specified operation situation becomes a predetermined value, and provides the control variable to a traffic management system.

FIG. 1



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Description

Technical Field

[0001] The present invention relates to a traffic demand control device.

Background Art

[0002] As a background art of the technical field, there is a technique disclosed in JP 2009-61984 A (PTL 1). According to the technique disclosed in this publication, a traveler R appearing in a station A to be an object station selects either one of actions (1) "waiting" that he/she waits for resumption of an operation and (2) "detour" that he/she selects a detour route detouring in an operation interruption section, when a planned route moving toward a station B is interrupted in operation, and this selecting action is determined according to a route selection model to be a logit model. That is, a selection probability Pa of the detour is calculated based on utility Ua with respect to the "detour" and utility Uu with respect to the "waiting", and the "detour" and "waiting" are selected according to the calculated selection probability Pa. In addition, there is a technique disclosed in JP 2010-18221 A (PTL 2). According to the technique disclosed in this publication, based on estimated transportation obstruction, a simple estimation timetable obtained by correcting a scheduled time table without performing operation arrangement is created as a provisional operation arrangement proposal, and traveler flow simulation relative to the provisional operation arrangement proposal is performed. As the result of the traveler flow simulation, a traveler flow estimation result such as action record of the respective travelers when a train is operated according to the provisional operation arrangement proposal and evaluation of the provisional operation arrangement proposal are obtained. Subsequently, based on the simulation result, a new provisional operation arrangement proposal obtained by correcting a dissatisfaction point of the provisional operation arrangement proposal is created. Thereafter, the traveler flow simulation relative to the new provisional operation arrangement proposal and the creation of the new provisional operation arrangement proposal obtained by correcting the dissatisfaction point of the provisional operation arrangement proposal are repeatedly performed. Then, the provisional operation arrangement proposal with the "best" evaluation is output as an operation arrangement proposal out of the provisional operation arrangement proposals which are repeatedly created.

Citation List

Patent Literatures

[0003]

PTL 1: JP 2009-61984 A
PTL 2: JP 2010-18221 A

Summary of Invention

Technical Problem

[0004] In the PTL 1, the utility Ua with respect to the "detour" and the utility Uu with respect to the "waiting" are calculated by a total required time and a waiting time until an operation resumption period, and the selection probability Pa of the detour is calculated, so that the detour action of the traveler is simulated. Meanwhile, in this known example, a means for setting the total required time and the waiting time until the operation resumption period is not provided such that the selection probability Pa has a predetermined value. Accordingly, when the timetable is disrupted, it is not possible to control distribution of the "waiting" travelers and the "detour" travelers and distribution of railroad congestion.

[0005] Furthermore, in the PTL 2, the railroad traveler flow during the obstruction is simulated, and the timetable is created to minimize non-utility of the traveler. However, in this known example, the timetable can be created to minimize the non-utility of the traveler who selects the route, but it is difficult to control the flow of traveler to optimize the load on the entire railroad network.

[0006] An object of the present invention is to provide control information such that each of traffic means has a desired usage probability in a traffic network in which a plurality of traffic means exist.

Solution to Problem

[0007] In order to solve the above problems, for example, a configuration disclosed in the appended claims is employed.

[0008] The present application includes a plurality of solutions to the above problems, and examples thereof include a traffic demand control device including: a storage unit that stores operation situation data indicating the past operation situation, a traveler flow history indicating a usage history of a traffic means of a traveler, and a control variable functioning as a determination criterion when the traveler selects the traffic means; and a computation processing unit that obtains a usage probability of the traveler for each traffic means in association with a departure place or a destination place, from the operation situation data and the traveler flow history that are stored in the storage unit, wherein the computation processing unit obtains the control variable such that the usage probability of each traffic means in a specified operation situation becomes a predetermined value, and provides the control variable to a traffic management system.

Advantageous Effects of Invention

[0009] The present invention can provide control information such that each of traffic means has a desired usage probability in a traffic network in which a plurality of traffic means exist.
[0010] Thus, for example, the travelers are distributed to a plurality of traffic means or traffic routes, and traffic facilities can be controlled such that a load is not concentrated on one traffic facility. Accordingly, it is possible to achieve an optimum traveler flow as an overall urban traffic including a railroad or a bus.
[0011] Other problems, configurations, and effects will be apparent from the following description of embodiments.

Brief Description of Drawings

[0012]

[FIG. 1] FIG. 1 is a configuration diagram of a traffic demand control device according to a first embodiment.
[FIG. 2] FIG. 2 illustrates an example of a traffic route data table.
[FIG. 3] FIG. 3 illustrates an example of a place information data table.
[FIG. 4] FIG. 4 is a diagram illustrating a relation between an area and traffic route information or place information.
[FIG. 5] FIG. 5 illustrates an example of a timetable information data table.
[FIG. 6] FIG. 6 illustrates an example of an operation trouble and accident data table.
[FIG. 7] FIG. 7 illustrates an example of a traveler flow history data table.
[FIG. 8] FIG. 8 illustrates an example of a processing procedure of a traveler flow estimation unit.
[FIG. 9] FIG. 9 illustrates an example of input information for calculating a parameter of utility function in a traveler flow estimation unit.
[FIG. 10] FIG. 10 illustrates an example of an output result of the traveler flow estimation unit.
[FIG. 11] FIG. 11 illustrates an example of a processing procedure of a traffic demand adjustment unit.
[FIG. 12] FIG. 12 illustrates an example where a route selection probability is calculated in a traffic demand control unit.
[FIG. 13] FIG. 13 is a diagram illustrating an example of visualization of demand control in an operation schedule creation unit.
[FIG. 14] FIG. 14 is a configuration diagram of a traffic demand control device according to a second embodiment.
[FIG. 15] FIG. 15 illustrates an example of information stored in a traveler flow history database 110 in the traffic demand control device according to the second embodiment.
[FIG. 16] FIG. 16 illustrates an example of a processing procedure of a route set creation unit.
[FIG. 17] FIG. 17 is a diagram illustrating an example of an original route set generated from probe information before a route set creation process.
[FIG. 18] FIG. 18 is a diagram illustrating an example of a route set after a route set creation process.

Description of Embodiments

[0013] Examples will be described below with reference to the accompanying drawings.

First Embodiment

[0014] In this embodiment, examples of a traffic demand control device for performing traffic demand control and an operation management device for creating an operation schedule or providing information for a user will be described.
[0015] FIG. 1 is a diagram illustrating an example of a configuration of a traffic demand control device according to this embodiment. A traffic demand control device 100 includes a storage unit 130 in which various programs or databases are stored and a computation processing unit 120 for performing various types of computation. The storage unit 130 stores a traffic route database 108 and an operation trouble and accident information database 109 serving as operation information 101, and stores a traveler flow history database 110 serving as traveler flow information 102. Here, the traffic

route database 108 includes a traffic route data table (see FIG. 2), a place information data table (see FIG. 3), and a timetable information data table (see FIG. 5) which will be described below. In addition, the computation processing unit 120 includes a traveler flow estimation unit 103 and a traffic demand adjustment unit 104 which are software executed by the computation processing unit 120, the traveler flow estimation unit 103 being configured to estimate the traveler flow and the traffic demand adjustment unit 104 being configured to adjust a usage probability of the traveler for each traffic means.

[0016] In addition, the traffic demand control device 100 includes an input device 150 configured by a keyboard, a mouse, and the like and an output device 140 configured by a display and the like.

[0017] In addition, the traffic demand control device 100 is connected to an operation management device 160 that performs an operation schedule and an operation management of a railroad or a bus. The operation management device 160 includes an operation schedule creation unit 105 for creating the operation schedule of the railroad or the bus, an information provision unit 106 for providing information to a user, and an operation management unit 107 for performing the operation management according to the operation schedule created by the operation schedule creation unit 105.

[0018] In this embodiment, the computation processing unit 120 is configured by, for example, a CPU, and has various types of software as programs to be executed by the computation processing unit 120. However, the computation processing unit 120 can be also implemented by hardware which is designed with, for example, an integrated circuit for each function or process. In addition, the operation management device 160 is provided separately from the traffic demand control device 100. However, the function provided in the operation management device 160 may be executed by the computation processing unit 120, and a plurality of processes to be executed by the computation processing unit 120 and the operation management device 160 may be implemented by separate hardware for each function.

[0019] An operation of each unit provided in the traffic demand control device 100 will be described below in detail.

[0020] FIG. 2 is a diagram illustrating an example of a traffic route data table stored in the traffic route database 108 provided in the operation information management unit 101. The traffic route data table 200 is stored with data configured by each of elements of a record ID 201, a departure place 202, an arrival place 203, a name of traffic route 204, a distance 205, a fare 206, and a standard required time 207. The record ID 201 is an ID which is uniquely allocated to each record indicating traffic route data. The departure place 202 and the arrival place 203 correspond to combinations of a departure place and an arrival place of a traffic facility of each traffic route data. The place corresponds to a station when the traffic facility is a railroad or a bus stop when the traffic facility is a bus. The name of traffic route 204 is a name of traffic routes to which the departure place 202 and the arrival place 203 belong, respectively. The distance 205, the fare 206, and the standard required time 207 are data indicating a distance, a fare, and a standard required time between the departure place 202 and the arrival place 203.

[0021] FIG. 3 is a diagram illustrating an example of a place information data table stored in the traffic route database 108 provided in the operation information 101. A place information data table 300 is stored with data configured by each of elements of a record ID 301, a name of place 302, an address 303, a coordinate 304, and an area ID 305. The record ID 301 is an ID which is uniquely allocated to each record indicating place information data. The name of place 302 is information corresponding to the departure place 202 or the arrival place 203. The address 303 is address information of the place 302. The coordinate 304 is information indicating latitude and longitude in which the name of place 302 is present. The area ID 305 is an ID for identifying an area to which the place belongs. The area ID is obtained in such a manner that the overall urban area covered with an urban traffic represented by the traffic route is divided in a predetermined range depending on a position of the place and is allocated by a unique ID. As a dividing method, a method of dividing into a rectangular shape having a predetermined size depending on positional information of the place is considered. Alternatively, the dividing may be performed in an address unit. Generally, one area includes a plurality of types of place information. FIG. 4 is a diagram illustrating an example of a relation between the area ID and the traffic route information or the place information. The relation between the area ID and the traffic route information or the place information satisfies the following relation, for example. A departure area 1 (401) and a destination area 2 (402) represented by a rectangular shape are present, stations A and C as a place are present in the departure area 1, and stations B and D are present in the destination area 2. The stations A and B are connected to each other through a traffic route X, and the stations C and D are connected to each other through a traffic route Y. With respect to the place and the traffic route, a railroad or a bus is considered as a public traffic.

[0022] FIG. 5 is a diagram illustrating an example of timetable information data stored in the traffic route database 108 provided in the operation information 101. A timetable information 500 stores timetable information serving as operation information data of the railroad or the bus. FIG. 5 is a diagram illustrating an example of the timetable information. In the timetable information 500, time 501 is indicated on a horizontal axis and a position 502 of a station or a bus stop is indicated on a vertical axis, and a line 503 represents an operation of one railroad or bus. Thus, it is possible to represent when and where any railroad or bus is present at the station. In addition, information of an operation interval for each traffic route is also stored.

[0023] FIG. 6 is a diagram illustrating an example of an operation trouble and accident data table stored in the operation trouble and accident information database 109 provided in the operation information 101. The operation trouble and accident data table 600 is stored with operation trouble and accident data which has occurred in the past and is stored with data configured by each of elements of a record ID 601, a date 602, a time of occurrence 603, an expected time for resumption of operation 604, a traffic route of occurrence 605, a location of occurrence 606, a cause of occurrence 607, and a time of operation normalization 608. The record ID 601 is an ID which is uniquely allocated to each operation trouble and accident data. The date 602 is a date on which operation trouble and accident has occurred. The time of occurrence 603 is a time at which the operation trouble and accident has occurred. The expected time for resumption of operation 604 is a time at which the resumption of operation of the traffic facility is expected after the operation trouble and accident has occurred. The traffic route of occurrence 605 is a name of traffic route at which the trouble and accident has occurred. The location of occurrence 606 is a place where the trouble and accident has occurred. The cause of occurrence 607 is a cause by which the operation trouble and accident has occurred. The time of operation normalization 608 is a time at which a normal operation of the traffic facility is restored. The difference between the time of operation normalization 608 and the expected time for resumption of operation 604 is as follows. The expected time for resumption of operation is a time at which the operation is predicted to be resumed by management personnel, who manages the operation immediately after the accident occurs, based on the past instance or the site situation. In contrast, the time of operation normalization 608 is a time at which the normal operation of the traffic facility is actually restored. At the present time, when the accident or trouble occurs, the expected time for resumption of operation is guided to the traveler.

[0024] FIG. 7 is a diagram illustrating an example of a traveler flow history data table stored in the traveler flow history database 110 provided in the traveler flow information 102. The traveler flow history data table 700 is stored with data configured by each of elements of an ID 701, an entrance time 702, an exit time 703, an entrance station 704, and an exit station 705. The entrance and exit history data recorded in each record is generated from information of an IC card ticket or a magnetic ticket that has passed through an automatic ticket gate installed at a ticket gate of each station, for example, when the railroad is used as a traffic facility. The ID 701 is an ID for identifying entrance and exit information stored in each record and is attached for each trip (one trip indicates a path between the entrance and the exit into/from the traffic-route facility). The entrance time 702 is a time at which the traveler enters the entrance station 704. The exit time 703 is a time at which the traveler exits from the exit station 705. A traffic route to be used 706 is a traffic route which is used by the traveler. In addition, when the traffic facility is the bus or the like, information on each of a getting-on time, a getting-off time, a getting-on place, and a getting-off place may be stored, instead of the entrance time 702, the exit time 703, the entrance station 704, and the exit station 705.

[0025] In this embodiment, the traffic demand control device of the traffic facility is provided in which the data tables stored in the traffic route database 108 and the operation trouble and accident information database 109 in the operation information 101 and the data table stored in the traveler flow history database 110 in the traveler flow information 102 are respectively used as input information. Specifically, the traffic demand control is processed as the following procedures.

[0026] In the traveler flow estimation unit 103, a process of estimating the traveler flow based on the past data instance is performed. The traffic demand adjustment unit 104 performs a process of calculating a selection probability of the traffic facility based on the estimated traveler flow information. Then, a method of adjusting the selection probability for each traffic route and performing the demand control when the operation trouble occurs is decided based on the calculated selection probability. In the operation schedule creation unit 105, an operation schedule of each traffic facility is decided based on the decided demand control information. In the information provision unit 106, the decided demand control information is provided to the user of the traffic facility. In the operation management unit 107, the operation of the traffic facility of the train or the bus is managed based on the decided operation schedule.

[0027] Each of processes will be described below.

[0028] In the traveler flow estimation unit 103, a process of estimating a traveler flow is performed based on instances of past data. In the present embodiment, a traffic route selection model is constructed based on a discrete selection model, and thus the estimation of the traveler flow is performed. The traffic route selection model based on the discrete selection model is a model on the premise that a utility function of a traffic route is defined and a traveler selects a traffic route of larger selection probability based on a utility value that is calculated by the utility function. For example, in the case of considering the movement from a certain departure area "i" to a destination area "j", there are two moving means of a traffic route X and a traffic route Y. When a utility value of the traffic route X(Y) is defined as UX(Y), selection probability PX(Y) that the traveler selects the traffic route X is expressed by Formulas (1) and (2).

$$PX = Pr\ [UX > UY] \quad \dots (1)$$

$$PY = 1 - PX \quad \dots (2)$$

[0029] An example of representative discrete selection model is a logit model that is expressed by Formula (3).

$$PX = \exp(UX)/\{\exp(UX) + \exp(UY)\} \dots (3)$$

[0030] Therefore, when the value of the utility function is changed, the selection probability is also changed accordingly.

[0031] In this embodiment, the logit model will be described below as an estimation example of traveler flow. FIG. 8 is a flowchart illustrating a processing procedure of the traveler flow estimation unit 103.

[0032] The traveler flow estimation unit 103 calculates a parameter for obtaining the selection probability of the traveler for a traffic means from the past instances that are stored in the traffic route database 108, the operation trouble and accident information database 109, and the traveler flow history database 110. For example, the calculation process is performed every one week whenever the data is stored to some extent.

[0033] First, the utility function is determined in step 801. In the logit model, the utility function is expressed by a linear formula such as Formula (4).

$$U_m = \sum_k \alpha_k X_{km} + \beta \quad \cdots (4)$$

[0034] In Formula (4), Um indicates a utility value of a traffic route m, α_k indicates a k-th explanatory variable, X_{km} indicates a parameter, and β indicates a constant term.

[0035] The utility value Um of the traffic route m is calculated using a utility function obtained by parameter estimation after the explanatory variable is determined. For this reason, step 801 indicates a process of selecting the explanatory variable based on the information stored in the traffic route database 108 and the operation trouble and accident information database 109 in the operation information management unit 101. That is, in step 801, it is determined which utility function is used in which an item among the "fare", the "required time", the "frequency of operation per time", and the "expected time until resumption of operation" is employed as an explanatory variable. Which item is employed may be determined in advance or may be input by a user during each calculation.

[0036] The information on the "fare" can be acquired by the fare 206 stored in the traffic route data table 200. The information on the "required time" can be acquired from the standard required time 207 or the difference between an entrance time 702 and an exit time 703 stored in the traveler flow history database 110. The "frequency of operation per time" can be acquired from a data table of timetable information. The information on the "period until the resumption of operation" can be acquired from the difference between the time of operation normalization 608 and the time of occurrence 603 stored in the operation trouble and accident data table 600.

[0037] In step 802, with reference to the operation trouble and accident information database 109 stored in the operation information management unit 101, information on an operation trouble and accident instance related to a departure place and a destination place, which are an area "i" and an area "j", respectively, is acquired. A method of acquiring the information of the operation trouble and accident instance is performed in the following procedures. First, the information on the departure place 202 and the arrival place 203 stored in the traffic route data table 200 is acquired based on the information on the traffic route of occurrence 605 stored in the operation trouble and accident data table 600. Subsequently, the information on the departure place 202 and the arrival place 203 is extracted with reference to the area ID 305 indicated in the place information data table 300, based on the acquired information on the departure place 202 and the arrival place 203 in which the area ID of the departure place is i and the area ID of the destination place is j.

[0038] In step 803, traveler flow history information that the area ID of the departure place is i and the area ID of the destination place is j is extracted from the traveler flow history database 110, based on the information of the departure place 202 and the arrival place 203 extracted in step 802.

[0039] In step 804, traffic-route selection result data is created based on the information extracted by steps 802 and 803. The traffic-route selection result data 900 is illustrated in FIG. 9. The traffic-route selection result data 900 is data in which each of explanatory variable values for each of the selected traffic routes and the traffic-route selection result of each traveler are stored.

[0040] The traffic-route selection result data 900 includes data of an ID 901, a fare 902, a required time 903, a frequency of operation per time 904, a period until the resumption of operation 905, and a selection result 907. The number of sets of these data is the number of traffic routes which the traveler uses between the departure area "i" and the destination area "j". In addition, as each traveler selects any one of traffic routes, the information is stored in the traveler flow history database 110. Meanwhile, the information of the traffic route which is not selected is referenced from the traffic route database 108.

[0041] The ID 901 is the ID 701 which is stored in the traveler flow history database 110. The fare 902 is a fare for each traffic route and corresponds to the fare 206 stored in the traffic route data table 200. The required time 405 is a required time until the departure place 202 and the arrival place 203 in which the area ID of the departure place is i and the area ID of the destination place is j, and is calculated from the entrance time 702 and the exit time 703 stored in the traveler flow history database 110 in the case of the selected traffic route. Meanwhile, in the case of the non-selected traffic route, the data of the standard required time 207 in the traffic route data table 200 is referenced. The frequency of operation per time 904 is a frequency of operation per time of each route and is referenced from the data table of timetable information 400. The period until the resumption of operation 407 can be acquired from the difference between the time of operation normalization 608 and the time of occurrence 603 stored in the operation trouble and accident data table 600. In the case of the route in which the operation trouble does not occur, a value "0" is stored. The selection result 906 is data indicating that which traffic route is selected by each traveler. For example, when the traveler selects a traffic route 1, a value of 1 is stored as the selection result of the traffic route 1, and a value of 0 is stored in other cases.

[0042] In step 805, a parameter value of utility function is calculated. Specifically, the parameter value is calculated as follows. The selection result of a traffic route "n" of a traveler "i" which is stored in the selection result 906 is referred to as $P_{in}^{\delta_{in}}$. Then, the simultaneous selection probability for achieving the selection results with respect to all of travelers is expressed by Formula (5).

$$L = P_{1n}^{\delta_{1n}} P_{2n}^{\delta_{2n}} \cdots P_{in}^{\delta_{in}} \cdots P_{Xn}^{\delta_{Xn}} \qquad \cdots (5)$$

[0043] Formula (5) represents a parameter function of the utility function, and it is possible to calculate the parameter of the utility function when the function L as a likelihood function is maximized by a maximum estimation method.

[0044] In step 806, it is determined whether the calculation of the parameter of the utility function is performed on the combination of all the departure area and the destination area. If the combination of the departure area and the destination area which are not calculated is present, the process returns to step 802 and the calculation is repeated. Meanwhile, when the calculation is terminated with respect to all of the combinations, the process is terminated in the traveler flow estimation unit. By the process of the traveler flow estimation unit 103, it is possible to obtain utility function to be used to calculate the utility value Um from the past record value of the traveler flow.

[0045] FIG. 10 is a diagram illustrating an output result of the traveler flow estimation unit 103. An output result 1000 stores a departure area ID 1001, a destination area ID 1002, and a parameter of utility function 1003 which is calculated for each of the departure area ID 1001 and the destination area ID 1002.

[0046] A processing operation of the traffic demand adjustment unit 104 will be described below.

[0047] In the traffic demand adjustment unit 104, the value of the explanatory variable is calculated based on the parameter of the utility function calculated in the traveler flow estimation unit 103 such that the selection probability of each route has a desired value with respect to a combination of the departure area and the destination area related to the traffic route in which the operation trouble or accident has occurred. Then, by the output of the calculated explanatory variable value to the operation schedule creation unit 105, a method of controlling the traffic means in the traffic route in which the operation trouble has occurred is decided.

[0048] The processing operation of the traffic demand adjustment unit 104 will be described below in detail.

[0049] FIG. 11 is a flowchart illustrating a processing procedure of the traffic demand adjustment unit 104.

[0050] In step 1101, information of operation trouble and accident which have occurred is input. When the operation trouble and accident information is generated, the information is transmitted to operators of traffic facilities through communication means. The information transmitted from the operators includes the date 602, the time of occurrence 603, the traffic route of occurrence 605, the location of occurrence 606, and the cause of occurrence 607 out of the operation trouble and accident data table 600.

[0051] In step 1102, a departure area and a destination area related to route and place in which the operation trouble and accident have occurred are extracted. Specifically, first, the departure area and the destination area through which the traffic route, in which the operation trouble and accident have occurred, passes are extracted. Then, from a set of combination of the extracted departure area and the destination area, a combination of the departure area and the destination area in which the operation trouble and accident place is present between the departure area and the destination area or in the area is extracted.

[0052] In step 1103, an explanatory variable is searched such that selection probability of a route stage with respect to the departure area and the destination area extracted in step 1102 is to be a predetermined value, and control information for adjusting the selection probability of the traffic route in each route is created. Specifically, the above process is performed as follows. The parameter of utility function 1003 related to the departure area and the destination area extracted from the output result 1000 of the traveler flow estimation unit 103 is selected. Subsequently, the selected parameter is substituted for Formula (4), and thus the utility function of the traffic route selection model is decided. Then, the selection probability represented in Formula (3) is calculated by the adjustment of the value of the explanatory variable in the utility function.

[0053] FIG. 12 illustrates an image of an adjustment method of the explanatory variable. FIG. 12 illustrates the change in the selection probability of traffic routes X and Y when the fare for the traffic route X is changed, the fare being an example of the explanatory variable. The demand adjustment is performed as follows. During a normal time at which the operation trouble and accident does not occur, the fare of the traffic route X and the value of the selection probability of the traffic routes X and Y are points indicated by 1201. Here, when the operation trouble occurs, the value of the fare to be a certain selection probability, for example, to be in the range indicated by 1102 is searched from the above value. The same process is also performed on other explanatory variables, for example, the "required time", the "frequency of operation per time", and the "period until resumption of operation", and the values of the explanatory variables are searched to be a certain selection probability. With respect to the "period until resumption of operation", since it is still undecided in the stage where the operation trouble occurs, an estimation value is designated based on the past trouble instance. The searching can be realized by a generally-known optimization technique with constraint condition using the selection probability as an objective function. Alternatively, a traffic administrator himself may set a certain selection probability instead of calculating the selection probability using the optimization technique.

[0054] In step 1104, information of the determined explanatory variable is transmitted to the operation schedule creation unit, as control information of the traffic means.

[0055] In the operation schedule creation unit 105, an operation schedule of the traffic means in each route is created using the control information of the traffic means created in the traffic demand adjustment unit 104 as input information. Specifically, the operation timetable is created by the known timetable creation algorithm approach using the constraint condition such as the "required time", the "frequency of operation per time", or the "period until resumption of operation" which is given as control information.

[0056] The operation schedule creation unit 105 includes a means for visualizing the selection probability of the traffic facilities. For example, as illustrated in FIG. 13, it is considered that a place 1302 and a traffic route 1303 in which the trouble have occurred, a departure area 1305 and a destination area 1306 related to a traffic route 1304, and changes in selection probability 1307 and 1308 before and after the trouble occurs in each of traffic routes are displayed onto an urban traffic network 1301, and are displayed to a user of the traffic demand control device through the output device 140.

[0057] The information provision unit 106 is configured to guide the control information to the traveler. Specifically, the information provision unit 106 transmits the control information such as the "required time", the "frequency of operation per time", or the "period until resumption of operation" to a guide board installed in a station or a bus stop or to a mobile terminal carried by the traveler, and is used such that the traveler facilitates selection of the traffic means.

[0058] The operation management unit 107 is configured to control various controllers such as signal devices so as to operate a train and a bus based on the operation schedule. The operation management can be performed by the known technique.

Second Embodiment

[0059] In this embodiment, an example of a traffic demand control device will be described which can perform not only demand control of a public traffic such as a train or a bus but also control a road traffic on which a general vehicle travels.

[0060] FIG. 14 is an example of a configuration diagram illustrating a traffic demand control device 1400 according to the second embodiment.

[0061] From the traffic demand control device 100 illustrated in FIG. 1, configurations given by the same reference numeral and portions having the same function as in FIG. 1 are not described.

[0062] The traffic demand control device 1400 according to the second embodiment is configured to include a road database 1401, which is further provided in operation information 101, and a route set creation unit 1402 in addition to the configuration of the first embodiment. By the addition of these configurations, it is possible to also perform demand control of a road traffic on which a general vehicle travels.

[0063] The traffic demand control device 1400 will be described below.

[0064] The road database 1401 is stored with information which constitutes a road map, the information including a node ID or a link ID, and a road width or a road type of national road and prefectural road.

[0065] An operation trouble and accident data table 600 of the second embodiment differs from that of the first embodiment as follows. The instances of trouble and accident in the case of the road traffic can be expressed by whether the road passing is prohibited or the lane is regulated in the case of the road traffic, while the traffic facility stops the operation. Accordingly, the expected time for resumption of operation 604, the traffic route of occurrence 605, the time of operation normalization 608 which are the information stored in the operation trouble and accident data table 600 in the first embodiment correspond to an expected time for resumption of normal passing, a traffic route of occurrence, and a time of passing normalization in the second embodiment, respectively.

[0066] In the second embodiment, traveler flow information based on probe data collected from a vehicle traveling on the road is further stored in a traveler flow history database 110 provided in a traveler flow information management unit

102.

[0067] FIG. 15 is a diagram illustrating an example of a traveler flow history data table stored in the traveler flow history database 110 provided in the traveler flow information management unit 102, the traveler flow history data table being additionally stored in the second embodiment. A traveler flow history data table 1500 includes a vehicle ID 1501 for identifying the vehicle from which the probe data is collected, a road start point node ID 1502 and a road terminal point node ID 1503 for identifying a road link from which the probe data is collected, a time of vehicle inflow 1504 at which the vehicle enters the road link, a time of vehicle travel 1505 when the vehicle passes through the road link, and a travel distance 1506.

[0068] The route set creation unit 1402 is configured to create a set of routes advancing from a certain departure area to a certain destination area on the road. In the case of considering the road traffic according to the second embodiment, it is considered that the traffic routes advancing from a certain departure area to a certain destination area have many different traffic routes as compared with the case of considering only a public traffic. In the case of obtaining a set of route by assuming each of routes having slightly different travel routes as a separate route, probe data obtained by traveling along each of the routes is reduced, and it is not possible to create a discrete selection model with high reliability. In the route set creation unit 1402, when a process is performed in which the routes to be regarded as the same route from a set of multiple different routes between a certain departure area and a certain destination area are regarded as one route, a process of creating a set of routes to be choice alternatives from the departure area to the destination area is performed.

[0069] A process operation of the route set creation unit 1402 will be described below.

[0070] FIG. 16 is a flowchart illustrating the process operation of the route set creation unit 1402.

[0071] In step 1601, among the probe data stored in the traveler flow history data table 1501, probe information related to all vehicles which flows out from an area "i" and flows in an area "j" is extracted. A method of setting the area is similar to that in the first embodiment.

[0072] FIG. 17 illustrates an image of the probe information data related to all vehicles which flows out from an area "i" and flows in an area "j". A road link represented by a set of pairs of the start point node ID 1502 and the terminal point node ID 1503 constituting the probe information is indicated by reference numeral 1701. One route 1702 is represented by a set of road link 1701. In addition, since a plurality of vehicles may use the same road, it is considered that a road link constituting another traffic route is overlapped with one traffic route.

[0073] In step 1602, from the data extracted in step 1601, a road link line directed toward the area "j" from the area "i" is extracted by paying attention to a certain vehicle.

[0074] In step 1603, it is determined whether a route registered as a route set is present. If present, the process proceeds to next step 1604. Meanwhile, if not present, the process proceeds to step 1606 to be described below.

[0075] In step 1604, the link line is compared with all of the registered routes, and an overlap ratio is calculated. The overlap ratio is a ratio at which the road links are overlapped with each other when the link lines are compared with each other. When the ratio is large, it means that the overlapping road links are large, and two link lines are similar to each other.

[0076] In step 1605, it is determined whether the overlap ratio is equal to or less than a threshold value. Then, when the overlap ratio is equal to or less than the threshold value with respect to all of the routes, it is determined that a similar route is not still registered in the route set. Then, the process proceeds to step 1606, and a toll for the traffic route and the required time are calculated. The toll is determined based on a management policy of a road charging system. For example, it is considered that the toll proportional to the travel distance is set. In addition, the required time is calculated based on a standard required time with respect to each road link which is registered in the road database. Alternatively, integration results of the time of vehicle travel of the road link line may be used.

[0077] In step 1607, one route where the area "i" is a destination place and the area "j" is a departure place is registered in the route set.

[0078] On the other hand, in step 1605, when the route having the overlap ratio equal to or more than the threshold value is present in the route set, it is determined that the route represented by the link line is already present in the route set. Then, the process returns to step 1602, and the same process is performed on the link line related to the next vehicle.

[0079] In step 1608, it is determined whether the process is terminated with respect to a travel route of all of the vehicles. Then, when the process is not terminated with respect to all of the vehicles, the process returns to step 1602, and the process is repeatedly performed.

[0080] In step 1609, it is determined whether the process is terminated with respect to a combination of all of the departure area and the destination area. When the process is not terminated, the process returns to step 1601, and the process is repeatedly performed.

[0081] FIG. 18 illustrates an example of the route stored in the route set after the process of the route set creation unit. This embodiment indicates an example where it is determined that two route from the departure area to the destination area are present. In addition, it is also considered that the stored route and the link line including most of the overlapped road links have the same route.

[0082] Besides the route set creation process indicated in this embodiment, for example, as disclosed in "Extraction of a set of sightseeing routes using screening method" (a handbook of lectures No. 22(1), Planning and management of land, October, 1999), a processing method may be employed in which a route search is performed more than once between any of the nodes existing in the departure area and the destination area and the searched result is regarded as a route candidate set.

[0083] The process operating of the traveler flow estimation unit 103 in this embodiment differs from that of the traveler flow estimation unit 103 in the first embodiment as follows. As the explanatory variable of the utility function, the fare, the required time, and the period until resumption of passing are used. In addition, the traffic route used in the creation of selection result data is determined as a traffic route in which a route having the largest overlap ratio of the probe data is used.

[0084] The operation of the traffic demand adjustment unit 104 in this embodiment is the same as in the first embodiment. However, the explanatory variable of the utility function differs from that in the first embodiment, and uses the fare, the required time, the period until resumption of passing.

[0085] In the operation schedule creation unit 105, a creation process of information, such as a fare, a required time, or a period until resumption of passing, to be provided to the vehicle is performed.

[0086] Thus, in this embodiment, the control of the road traffic along which not only the bus or train but also a general vehicle travels is also considered as choice alternatives of the traffic means, and the control can be performed such that the load is not concentrated on one traffic facility.

[0087] The present invention is not limited to the above-described embodiments, but includes various modifications. For example, a configuration in which the configurations of the first and second embodiments are combined is also considered. Further, the operation of the traffic demand control device according to the present invention is performed during the occurrence of the operation trouble, and can be performed even during a normal operation to distribute the load of the traffic route.

[0088] In addition, the above-described embodiments have been described in detail for easily understanding the present invention; however, the present invention is not always limited to an invention including all of the above-described structures. Further, the structure of an embodiment may be partially replaced with a structure of another embodiment, and the structure of another embodiment may be added to the structure of an embodiment. Still further, another structure may be partially added to, removed from, and replaced with each of structures of the embodiments.

[0089] In addition, the structures, functions, processing units, processing means, and the like described above may be partially or wholly achieved with hardware, for example, by being designed as an integrated circuit. The structures, functions, and the like described above may be achieved with software in such a manner that a processor interprets and executes programs achieving functions. The programs, tables, files, and the like have information for achieving the functions, and the information may be put in a recording device such as a memory, hard disk, and solid state drive (SSD), or a recording medium such as an IC card, SD card, and DVD.

[0090] A control line or an information line is shown which is considered to be necessary for description, and all control lines or information lines are not necessarily shown to describe a product. Actually, it may be considered that almost all the structures are connected to each other.

Reference Signs List

[0091]

100	traffic demand control device
101	operation information
102	traveler flow information
103	traveler flow estimation unit
104	traffic demand adjustment unit
105	operation schedule creation unit
106	information provision unit
107	operation management unit
108	traffic route database
109	operation trouble and accident information database
110	traveler flow history database
120	computation processing unit
130	storage unit
140	output device
150	input device
160	operation management device
1400	traffic demand control device

1401 road database
1402 route set creation unit

Claims

1. A traffic demand control device comprising:

a storage unit that stores operation situation data indicating the past operation situation, a traveler flow history indicating a usage history of a traffic means of a traveler, and a control variable functioning as a determination criterion when the traveler selects the traffic means; and
a computation processing unit that obtains a usage probability of the traveler for each traffic means in association with a departure place or a destination place, from the operation situation data and the traveler flow history that are stored in the storage unit,
characterized in that the computation processing unit obtains the control variable such that the usage probability of each traffic means in a specified operation situation becomes a predetermined value, and provides the control variable to a traffic management system.

2. The traffic demand control device according to claim 1, **characterized in that**
the operation situation data is stored with operation trouble information related to the past operation trouble, and the computation processing unit obtains the control variable such that the usage probability of the each traffic means becomes a predetermined value at the time of occurrence of an operation trouble that is an object.

3. The traffic demand control device according to claim 2, **characterized in that** the computation processing unit obtains a parameter necessary for obtaining the usage probability in association with a departure place or a destination place, from the control variable and the traveler flow history, and captures the operation trouble information related to an operation trouble of a target date for adjusting the usage probability to obtain the control variable using the parameter of the departure place or the destination place related to the operation trouble such that the usage probability becomes a predetermined value.

4. The traffic demand control device according to claim 1, **characterized in that** the storage unit further stores road map information, and the computation processing unit generates set information of a route, which is selected from a predetermined place to a destination place by the traveler, based on the traveler flow history and the road map information, selects a main route from the set information, and obtains a usage probability for each traffic means using the selected route.

5. The traffic demand control device according to claim 3, **characterized in that** the control variable is an explanatory variable in a discrete selection model, and
the computation processing unit obtains a parameter necessary for obtaining a utility value that a fare for use of the traffic means or a required time is the explanatory variable, and obtains the explanatory variable such that the usage probability for each traffic means becomes a predetermined value.

6. The traffic demand control device according to claim 3, **characterized in that**
the control variable is an explanatory variable in a discrete selection model, and
the computation processing unit obtains a parameter necessary for obtaining a utility value that a frequency of bus or train operation per time is the explanatory variable, and obtains the explanatory variable such that the usage probability for each traffic means becomes a predetermined value.

7. The traffic demand control device according to claim 1, **characterized by** further including an operation schedule creation unit that creates an operation schedule of the traffic means, based on the control variable.

8. The traffic demand control device according to claim 1, **characterized by** further including an information provision unit that guides the obtained control variable to the traveler who uses the traffic means.

FIG. 1

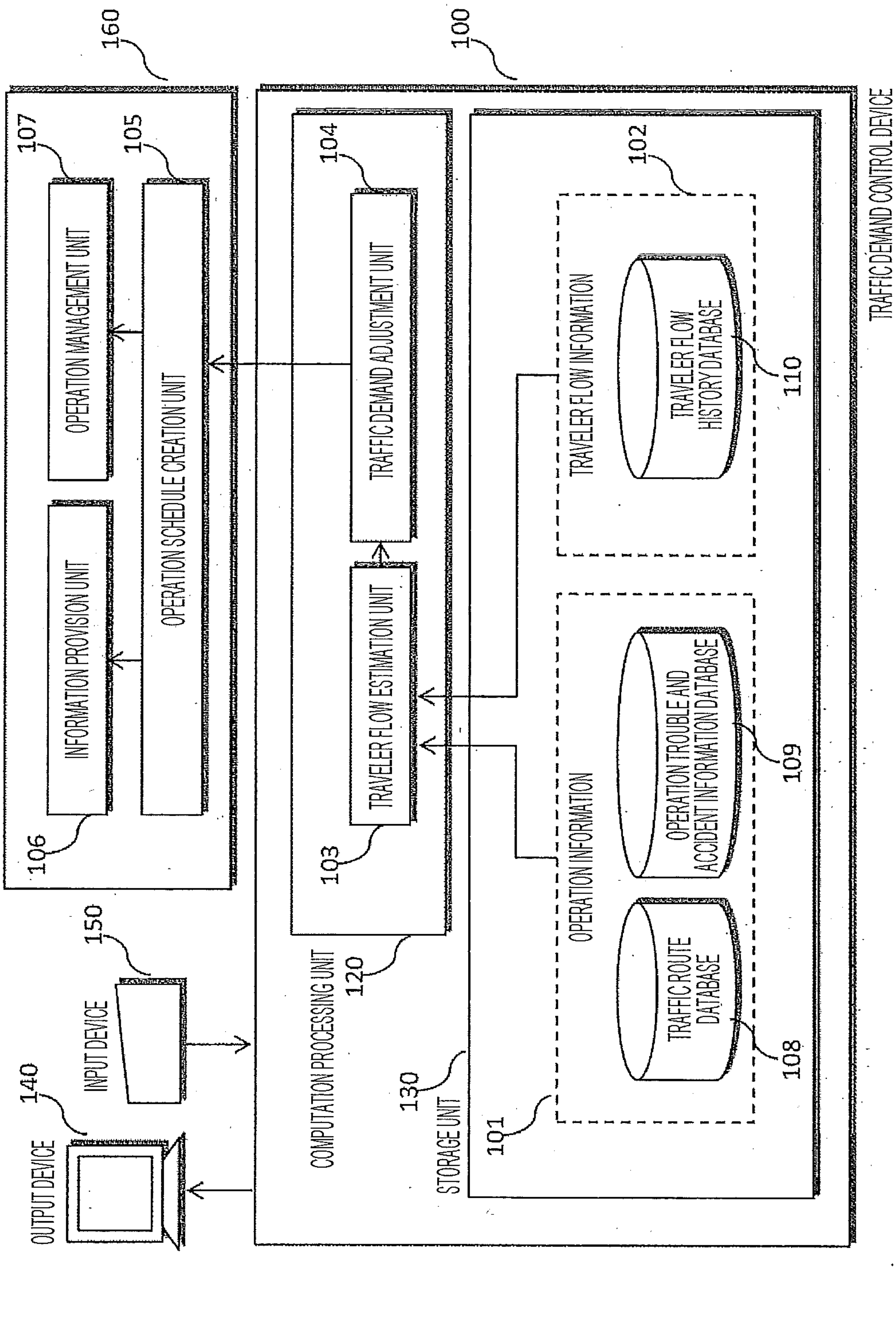

OPERATION MANAGEMENT DEVICE
160
107
105
OPERATION MANAGEMENT UNIT
INFORMATION PROVISION UNIT
OPERATION SCHEDULE CREATION UNIT
106
100
TRAFFIC DEMAND CONTROL DEVICE
104
TRAFFIC DEMAND ADJUSTMENT UNIT
TRAVELER FLOW ESTIMATION UNIT
103
COMPUTATION PROCESSING UNIT
120
102
TRAVELER FLOW INFORMATION
TRAVELER FLOW HISTORY DATABASE
110
OPERATION INFORMATION
OPERATION TROUBLE AND ACCIDENT INFORMATION DATABASE
109
TRAFFIC ROUTE DATABASE
108
101
130
STORAGE UNIT
INPUT DEVICE
150
OUTPUT DEVICE
140

FIG. 2

200

ID (201)	DEPARTURE PLACE (202)	ARRIVAL PLACE (203)	NAME OF TRAFFIC ROUTE (204)	DISTANCE (205)	FARE (206)	STANDARD REQUIRED TIME (207)
1	A	B	X	10	150	15
2	A	E	X		···	···
3	C	D	Y	11	160	12
···	···	···	···	···	···	···

FIG. 3

300

ID (301)	NAME OF PLACE (302)	ADDRESS (303)	COORDINATE (304)	AREA ID (305)
1	STATION A	"C" STREET, "B" TOWN, "A" CITY	LATITUDE: ○○DEGREES××MINUTES△△SECONDS LONGITUDE: ○○DEGREES××MINUTES△△SECONDS	1
2	STATION B	"F" STREET, "D" TOWN, "B" CITY	...	2
3	STATION C	...	...	1
4	STATION D	...	...	2

FIG. 4

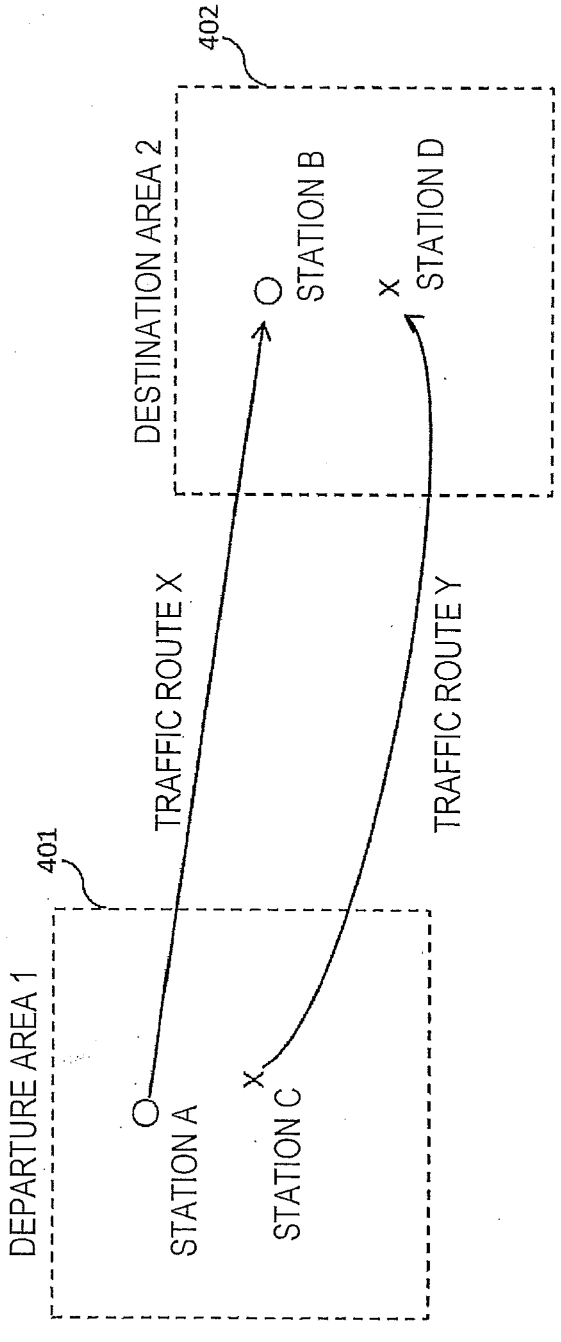
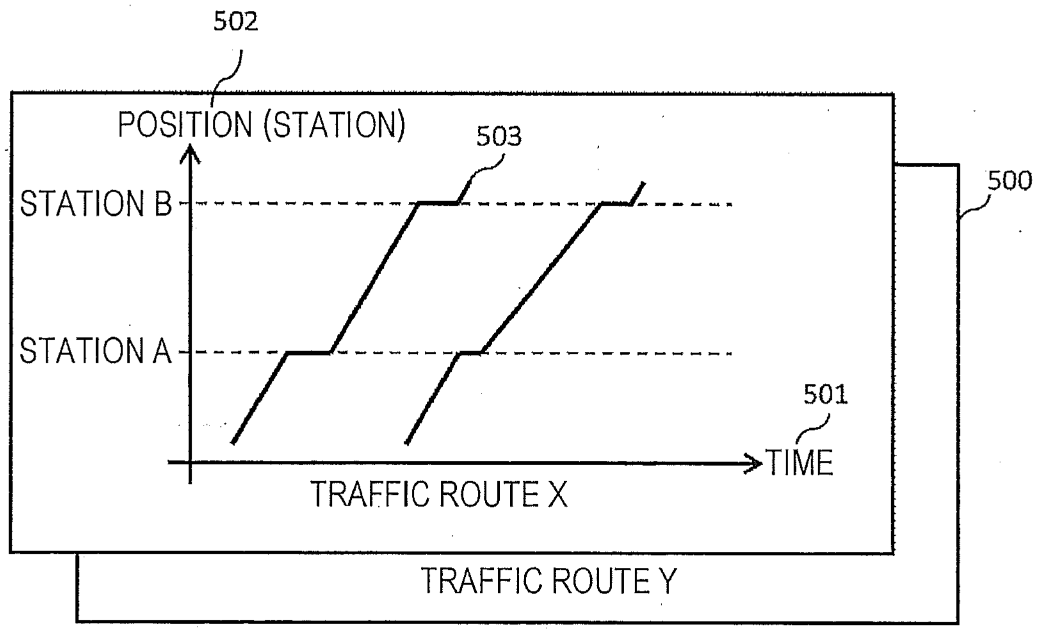

402
DESTINATION AREA 2
STATION B
STATION D
TRAFFIC ROUTE X
TRAFFIC ROUTE Y
401
DEPARTURE AREA 1
STATION A
STATION C

FIG. 5



502
POSITION (STATION)
503
STATION B
STATION A
501
TIME
TRAFFIC ROUTE X
TRAFFIC ROUTE Y
500

FIG. 6

600

ID (601)	DATE (602)	TIME OF OCCURRENCE (603)	EXPECTED TIME FOR RESUMPTION OF OPERATION (604)	TRAFFIC ROUTE OF OCCURRENCE (605)	LOCATION OF OCCURRENCE (606)	CAUSE OF OCCURRENCE (607)	TIME OF OPERATION NORMALIZATION (608)
1	2011-01-01	19:00	20:00	X	X1	FATAL ACCIDENT	21:00
2	2011-01-03	19:05	20:05	X	X2	TRAFFIC ACCIDENT	22:25
3	2011-02-01	19:10	20:10	Y	Y3	VEHICLE ACCIDENT	20:40
4	2011-03-01	19:15	19:45	Y	Y4	STOP OF PASSAGE	20:45
5	2011-04-01	19:20	20:20	Z	Z1	POWER FAILURE	21:10
...	...	...	...	...	...	...	...

FIG. 7

700

ID (701)	ENTRANCE TIME (702)	EXIT TIME (703)	ENTRANCE STATION (704)	EXIT STATION (705)	TRAFFIC ROUTE TO BE USED (706)
1	2010-01-01 19:00	2010-01-01 19:05	A	B	X
2	2010-01-01 19:05	2010-01-01 19:10	A	B	X
3	2010-01-02 07:00	2010-01-02 07:15	C	D	Y
...	...	...	...	...	...

FIG. 8

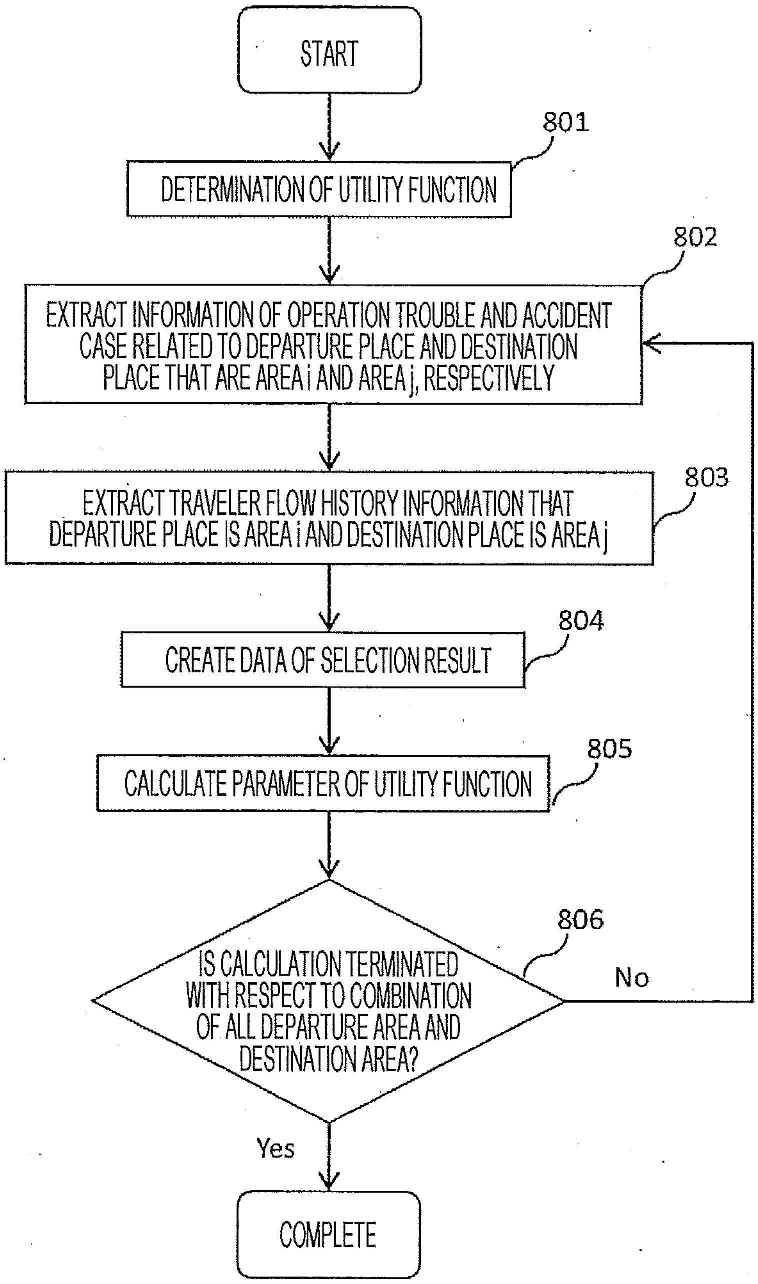

START
801
DETERMINATION OF UTILITY FUNCTION
802
EXTRACT INFORMATION OF OPERATION TROUBLE AND ACCIDENT CASE RELATED TO DEPARTURE PLACE AND DESTINATION PLACE THAT ARE AREA i AND AREA j, RESPECTIVELY
803
EXTRACT TRAVELER FLOW HISTORY INFORMATION THAT DEPARTURE PLACE IS AREA i AND DESTINATION PLACE IS AREA j
804
CREATE DATA OF SELECTION RESULT
805
CALCULATE PARAMETER OF UTILITY FUNCTION
806
IS CALCULATION TERMINATED WITH RESPECT TO COMBINATION OF ALL DEPARTURE AREA AND DESTINATION AREA?
No
Yes
COMPLETE

FIG. 9

900

ID (901)	TRAFFIC ROUTE 1, FARE (902)	TRAFFIC ROUTE 1, REQUIRED TIME (903)	TRAFFIC ROUTE 1, FREQUENCY OF OPERATION PER TIME (904)	TRAFFIC ROUTE 1, PERIOD UNTIL RESUMPTION OF OPERATION (905)	TRAFFIC ROUTE 2, FARE	TRAFFIC ROUTE 2, REQUIRED TIME	TRAFFIC ROUTE 2 FREQUENCY OF OPERATION PER TIME	TRAFFIC ROUTE 2, PERIOD UNTIL RESUMPTION OF OPERATION	⋮	⋮	⋮	⋮	TRAFFIC ROUTE 1, SELECTION RESULT (906)	TRAFFIC ROUTE 2, SELECTION RESULT	...
1	150	11	5	15	160	10	6	0	·	·	·	·	1	0	...
2	150	12	5	15	160	11	6	0	·	·	·	·	0	1	...
3	150	10	5	0	160	13	6	40	·	·	·	·	1	0	...
...	...	...	...	...	...	...	...	...	·	·	·	·	...	...	...

FIG. 10

1000

DEPARTURE AREA ID (1001)	DESTINATION AREA ID (1002)	PARAMETER OF UTILITY FUNCTION (1003)
1	2	α 1=XX1, α 2=YY1, α 3=ZZ1, α 4=AA1, β =BB1
1	3	α 1=XX2, α 2=YY2, α 3=ZZ2, α 4=AA2, β =BB2
...	...	...

FIG. 11

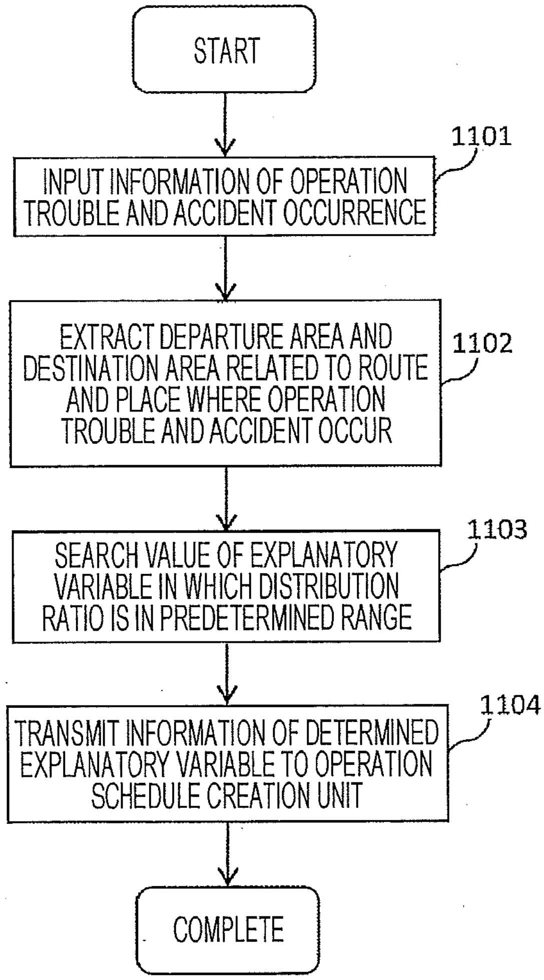

START
1101
INPUT INFORMATION OF OPERATION TROUBLE AND ACCIDENT OCCURRENCE
1102
EXTRACT DEPARTURE AREA AND DESTINATION AREA RELATED TO ROUTE AND PLACE WHERE OPERATION TROUBLE AND ACCIDENT OCCUR
1103
SEARCH VALUE OF EXPLANATORY VARIABLE IN WHICH DISTRIBUTION RATIO IS IN PREDETERMINED RANGE
1104
TRANSMIT INFORMATION OF DETERMINED EXPLANATORY VARIABLE TO OPERATION SCHEDULE CREATION UNIT
COMPLETE

FIG. 12

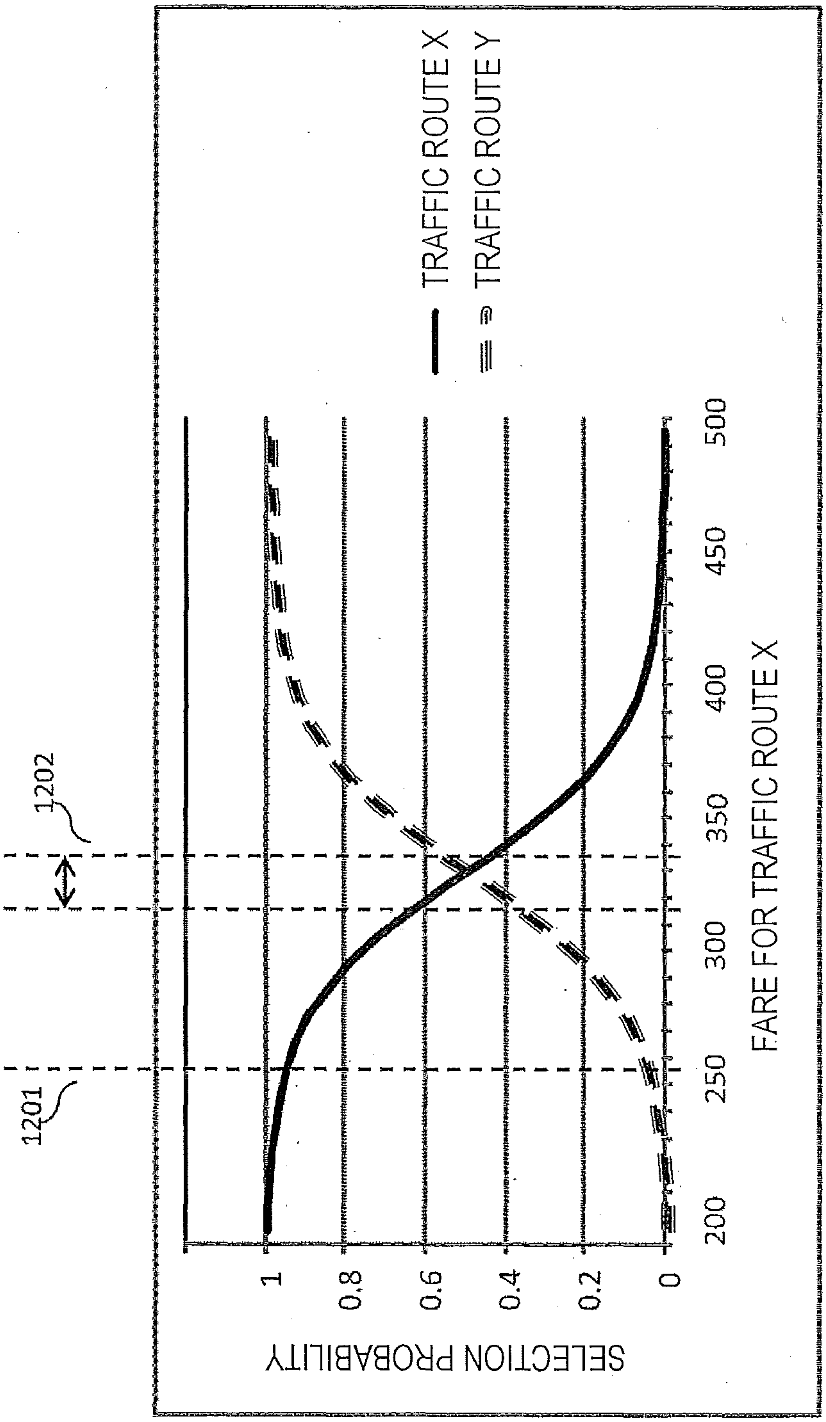

1201
1202
SELECTION PROBABILITY
0
0.2
0.4
0.6
0.8
1
200
250
300
350
400
450
500
FARE FOR TRAFFIC ROUTE X
TRAFFIC ROUTE X
TRAFFIC ROUTE Y

FIG. 13

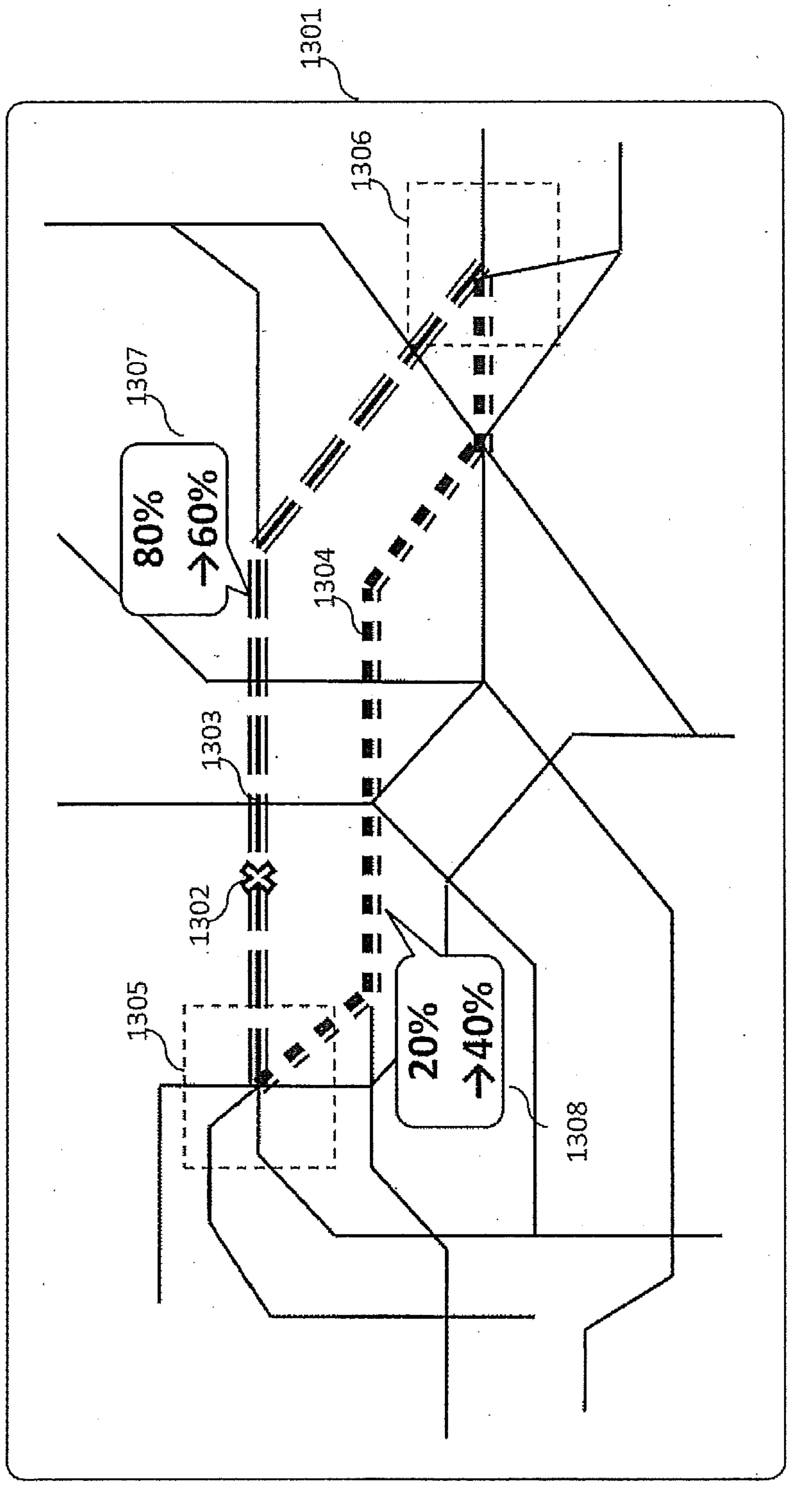


FIG. 14

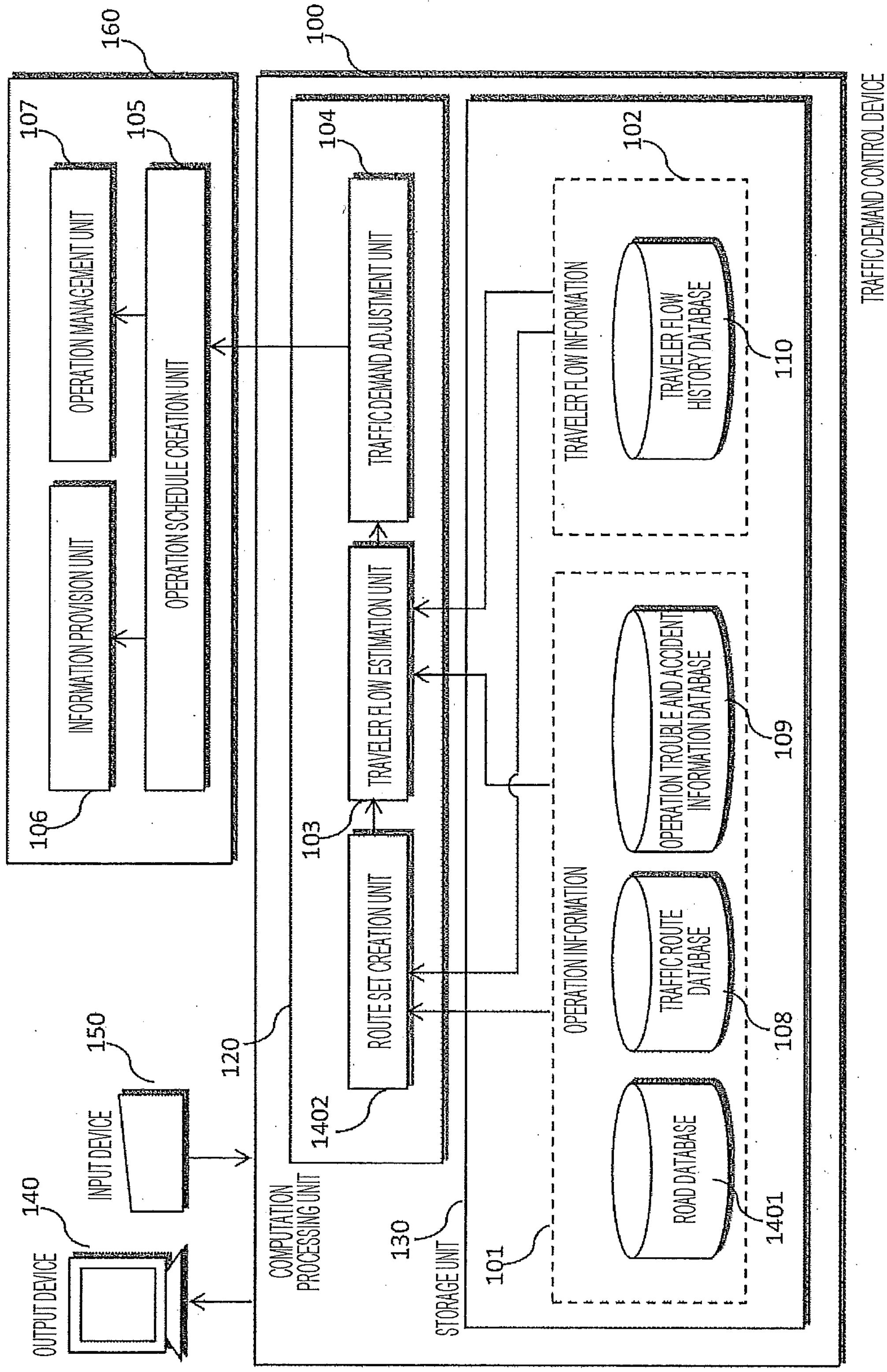

OPERATION MANAGEMENT DEVICE
160
107
105
OPERATION MANAGEMENT UNIT
INFORMATION PROVISION UNIT
OPERATION SCHEDULE CREATION UNIT
106
100
TRAFFIC DEMAND CONTROL DEVICE
104
TRAFFIC DEMAND ADJUSTMENT UNIT
TRAVELER FLOW ESTIMATION UNIT
103
ROUTE SET CREATION UNIT
1402
120
COMPUTATION PROCESSING UNIT
102
TRAVELER FLOW INFORMATION
TRAVELER FLOW HISTORY DATABASE
110
OPERATION INFORMATION
OPERATION TROUBLE AND ACCIDENT INFORMATION DATABASE
109
TRAFFIC ROUTE DATABASE
108
ROAD DATABASE
1401
101
130
STORAGE UNIT
150
INPUT DEVICE
140
OUTPUT DEVICE

FIG. 15

VEHICLE ID	START POINT NODE ID	TERMINAL POINT NODE ID	TIME OF VEHICLE INFLOW	TIME OF VEHICLE TRAVEL	TRAVEL DISTANCE
001	53393500001	53393500002	10:00	5 MINUTES	1km
...	...	...	...	...	...

FIG. 16

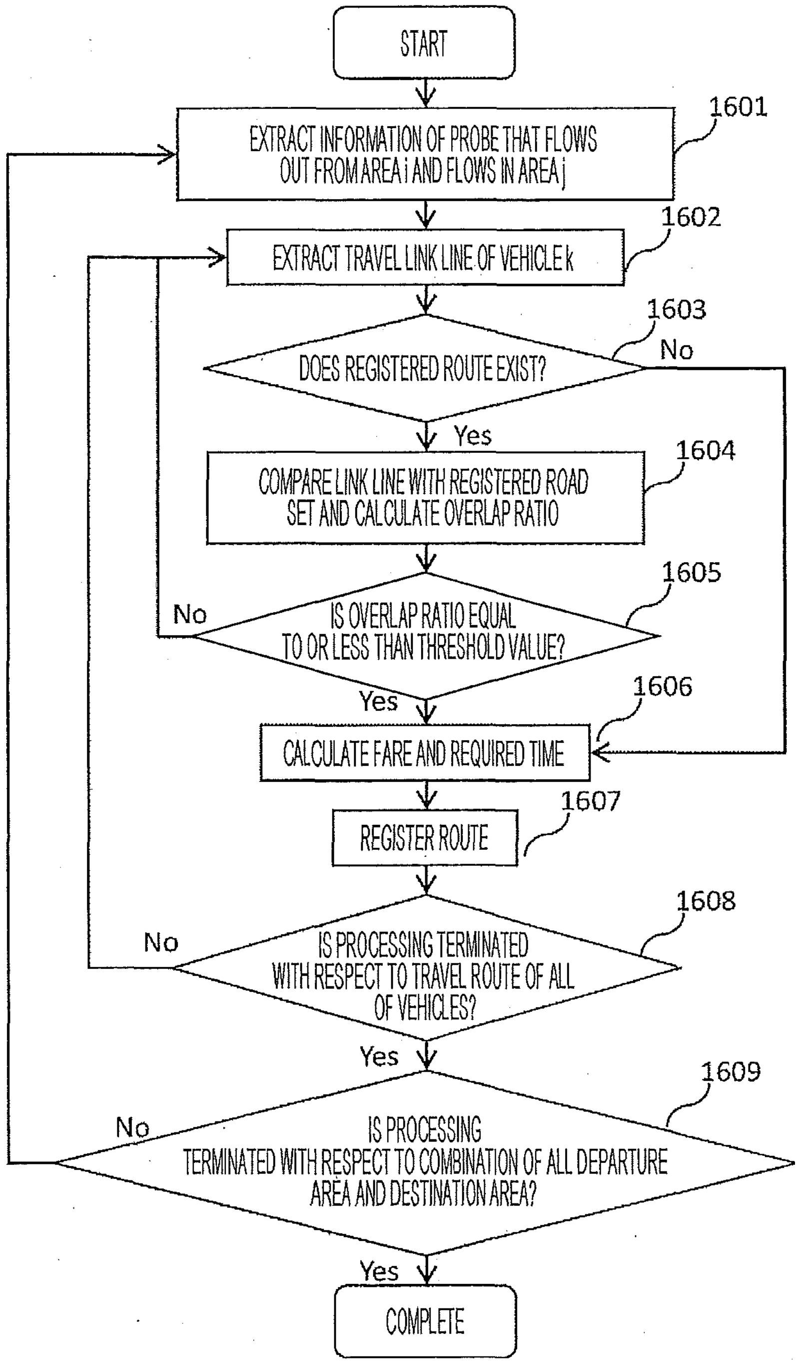
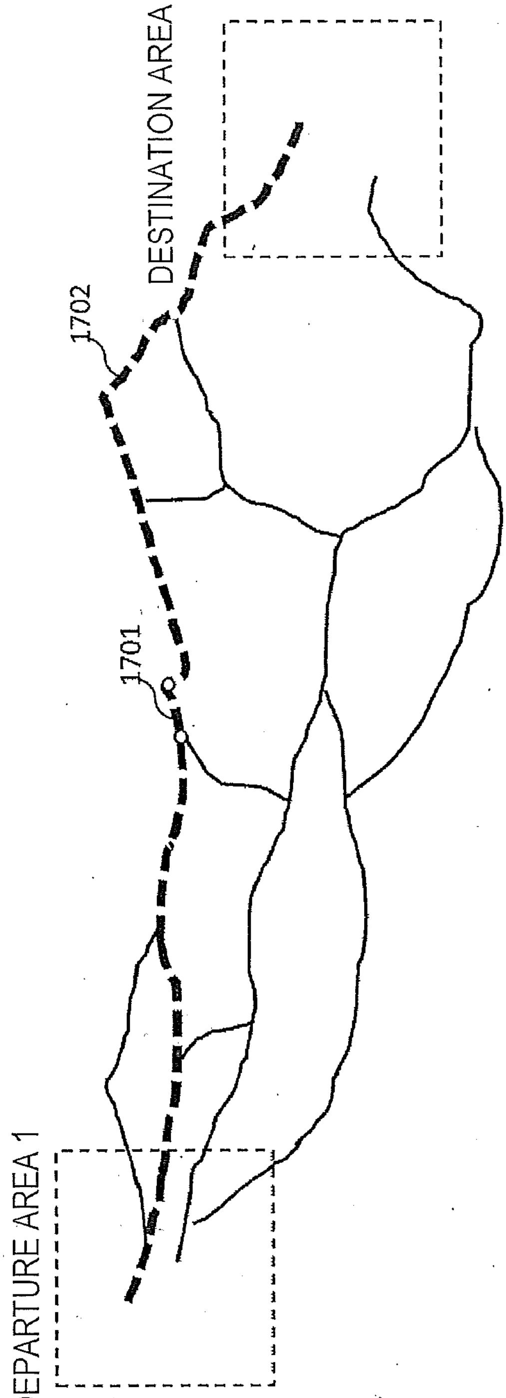

START
EXTRACT INFORMATION OF PROBE THAT FLOWS OUT FROM AREA i AND FLOWS IN AREA j
1601
EXTRACT TRAVEL LINK LINE OF VEHICLE k
1602
DOES REGISTERED ROUTE EXIST?
1603
No
Yes
COMPARE LINK LINE WITH REGISTERED ROAD SET AND CALCULATE OVERLAP RATIO
1604
IS OVERLAP RATIO EQUAL TO OR LESS THAN THRESHOLD VALUE?
1605
No
Yes
CALCULATE FARE AND REQUIRED TIME
1606
REGISTER ROUTE
1607
IS PROCESSING TERMINATED WITH RESPECT TO TRAVEL ROUTE OF ALL OF VEHICLES?
1608
No
Yes
IS PROCESSING TERMINATED WITH RESPECT TO COMBINATION OF ALL DEPARTURE AREA AND DESTINATION AREA?
1609
No
Yes
COMPLETE

FIG. 17



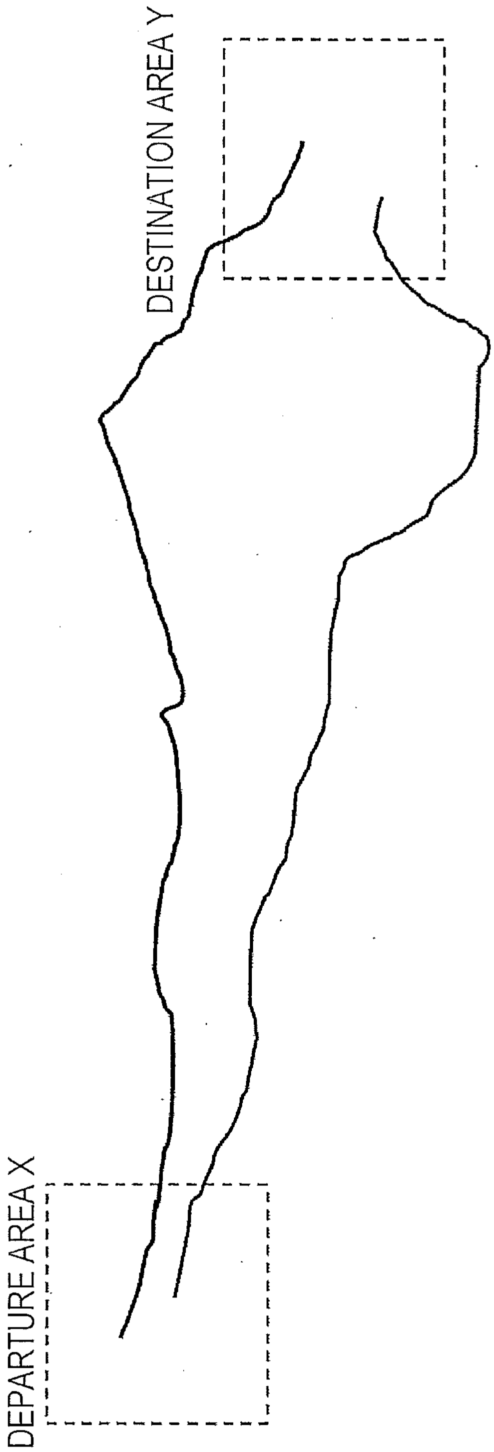


FIG. 18

INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2013/066416

A. CLASSIFICATION OF SUBJECT MATTER
B61L27/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B61L27/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2013
Kokai Jitsuyo Shinan Koho	1971-2013	Toroku Jitsuyo Shinan Koho	1994-2013

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2012-196987 A (Hitachi, Ltd., East Japan Railway Co.), 18 October 2012 (18.10.2012), entire text; all drawings (Family: none)	1-8
A	JP 2010-140074 A (Railway Technical Research Institute), 24 June 2010 (24.06.2010), paragraphs [0085] to [0116]; fig. 29 to 35 (Family: none)	1-8
A	JP 61-89165 A (Hitachi, Ltd.), 07 May 1986 (07.05.1986), entire text; all drawings (Family: none)	1-8

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 September, 2013 (03.09.13)	17 September, 2013 (17.09.13)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2009061984 A **[0002] [0003]**
- JP 2010018221 A **[0002] [0003]**