

DESCRIPTION

Title of Invention

TRAFFIC INFORMATION PROCESSING SYSTEM, DETECTION
DEVICE, SERVER DEVICE, TRAFFIC INFORMATION PROCESSING
METHOD, AND PROGRAM

Technical Field

[0001]

The present invention relates to, for example, a traffic information processing system, a detection device, a server device, a traffic information processing method, and a program in which traffic information is collected and processed.

Priority is claimed on Japanese Patent Application No. 2012-256520, filed November 22, 2012, the content of which is incorporated herein by reference.

Background Art

[0002]

In recent years, a system in which a detection device for detecting various pieces of information is mounted on a vehicle, and thereby, traffic information is collected, a state of a traffic jam is detected, and such information is fed back to a car navigation device of the vehicle, and has spread. For example, PTL 1 discloses a technology of dividing a map in a grid form, and

transmitting information indicating whether a vehicle has entered or exited an area in each grid to a center server device, such that a degree of congestion of the area corresponding to the grid is analyzed based on the number of vehicles present in the grid.

Patent Literature

[0003]

[PTL 1] Japanese Unexamined Patent Application
Publication No. 2011-070574

Summary of Invention

Technical Problem

[0004]

However, in the technology described in PTL 1, since the map is divided in the grid form and the number of vehicles in each grid is detected, it is likely to be unable to detect a congested road when there are a plurality of roads in the grid.

[0005]

The present invention provides a traffic information processing system, a detection device, a server device, a traffic information processing method, and a program capable of acquiring and processing traffic information related to each road.

Solution to Problem

[0006]

(1) According to a first aspect of the present

invention, a traffic information processing system is a traffic information processing system including a detection device mounted on a vehicle, and a server device, in which the detection device includes: a position detection unit that detects a position of the own device and acquires the time at which the position is detected; a segment detection unit that detects a segment correlating with the position detected by the position detection unit from a plurality of segments that are sections into which a road is divided; a segment change determination unit that determines whether the segment in which the own device exists has changed based on the segments sequentially detected by the segment detection unit; and a transmission unit that transmits information indicating the segment in which the own device exists, and information indicating the time at which the own device begins to be in the segment to the server device when the segment change determination unit has determined that the segment in which the own device exists has changed, and the server device includes a reception unit that receives the information indicating the segment and the information indicating the time from the detection device.

[0007]

According to such a configuration, it is possible to detect a segment in which the vehicle exists, and to transmit the information to the server device only when

there is a change in the sequentially detected segment. Therefore, it is possible to reduce the amount of information to be transmitted to the server device, and the server device can perform a process of detecting a state of traffic in units of segments based on previously selected information.

[0008]

(2) According to a second aspect of the present invention, in the above-described aspect, the detection device or the server device includes a travel direction determination unit that determines a travel direction of the vehicle in the segment based on the segment sequentially detected by the segment detection unit and information indicating a predetermined connection relationship between segments.

[0009]

According to such a configuration, it is possible to determine the travel direction of the vehicle based on the information regarding the detected segment and select the information regarding the segment according to each travel direction of the vehicle. The server device can detect the traffic information according to each direction of the road when detecting the traffic information.

[0010]

(3) According to a third aspect of the present invention, in the above-described aspect, the server

device includes a traffic information detection unit that calculates the number of vehicles that are in the segment at an arbitrarily determined time based on the information indicating the segment and the information indicating the time.

[0011]

According to such a configuration, the server device can calculate the number of vehicles that are in a certain segment at an arbitrarily determined time and provide the number as information indicating a degree of congestion.

[0012]

(4) According to a fourth aspect of the present invention, in the above-described aspect, the server device calculates an amount of passage time for the segment or an average speed of the vehicle that has passed the segment at an arbitrarily determined time based on the information indicating the segment and the information indicating the time.

[0013]

According to such a configuration, the server device can calculate the amount of passage time or the average speed required for passage of a certain segment and provide the amount of passage time or the average speed as information indicating a degree of congestion.

[0014]

(5) According to a fifth aspect of the present

invention, in the above-described aspect, the detection device includes an acceleration sensor that detects the speed of the vehicle, and when the vehicle exits the first segment and enters another segment, the segment detection unit detects the first segment as a segment in which the own device exists without detecting another segment in which the own device exists when a position of the own device is in a range of a predetermined distance from an end of the first segment, detects the other segment in which the own device exists when the position of the own device exists in a position that has been beyond the predetermined distance from the end of the first segment, calculates a time at which the own device begins to be in the other segment based on a time at which the other segment has been detected, the predetermined distance, and the speed of the vehicle detected by the acceleration sensor when the vehicle passes a point of the predetermined distance.

[0015]

According to such a configuration, at a branch point at which the detection of the position in the detection device is likely to be unstable, at which three or more segments are connected, a certain distance from the branch point is detected as an original segment, and a new segment is detected when the vehicle has been beyond the certain distance. Thus, it is possible to perform the

position detection in which an area in which detection precision is unstable is avoided. Further, with such a configuration, it is possible to calculate a time of passage of the branch point by detecting the speed of the vehicle when the vehicle has been beyond the certain distance.

[0016]

(6) According to a sixth aspect of the present invention, a detection device includes: a position detection unit that detects a position of the own device and acquires the time at which the position is detected; a segment detection unit that detects a segment correlating with the position detected by the position detection unit among a plurality of segments that are sections into which a road is divided; a segment change determination unit that determines whether the segment in which the own device exists has changed based on the segments sequentially detected by the segment detection unit; and a transmission unit that transmits information indicating the segment in which the own device exists, and information indicating a time at which the own device begins to be in the segment when the segment change determination unit has determined that the segment in which the own device exists has changed.

[0017]

(7) According to a seventh aspect of the present

invention, a server device includes: a position detection unit that detects a position of the own device and acquires the time at which the position is detected; a segment detection unit that detects a segment correlating with the position detected by the position detection unit from a plurality of segments that are sections into which a road is divided; a segment change determination unit that determines whether the segment in which the own device exists has changed based on the segments sequentially detected by the segment detection unit; and a transmission unit that transmits information indicating the segment in which the own device exists, and information indicating the time at which the own device begins to be in the segment when the segment change determination unit has determined that the segment in which the own device exists has changed, and the server device includes a reception unit that receives the information indicating the segment and the information indicating the time from a detection device mounted on the vehicle.

[0018]

(8) According to an eighth aspect of the present invention, a traffic information processing method is a traffic information processing method performed by a detection device mounted on a vehicle, and a server device, in which the detection device detects a position of the

own device and acquires a time at which the position is detected, sequentially detects a segment correlating with the detected position from a plurality of segments that are sections into which a road is divided, and determines whether the segment in which the own device exists has changed based on the sequentially detected segments, and transmits information indicating the segment in which the own device exists, and information indicating the time at which the own device begins to be in the segment when it is determined that the segment in which the own device exists has changed, and the server device receives the information indicating the segment and the information indicating the time from the detection device.

[0019]

(9) According to a ninth aspect of the present invention, a computer causes a computer to function as: position detection means for detecting a position of the own device and acquiring a time at which the position is detected; segment detection means for detecting a segment correlating with the position detected by the position detection means from a plurality of segments that are sections into which a road is divided; segment change determination means for determining whether the segment in which the own device exists has changed based on the segments sequentially detected by the segment detection means; and transmission means for transmitting information

indicating the segment in which the own device exists, and information indicating the time at which the own device begins to be in the segment when the segment change determination means has determined that the segment in which the own device exists has changed.

[0020]

(10) According to a tenth aspect of the present invention, a program causes a computer communicating with a detection device mounted on a vehicle to execute a process of receiving information indicating a segment and information indicating a time from the detection device, the detection device including a position detection unit that detects a position of the own device and acquires a time at which the position is detected, a segment detection unit that detects a segment correlating with the position detected by the position detection unit from a plurality of segments that are sections into which a road is divided, a segment change determination unit that determines whether the segment in which the own device exists has changed based on the segments sequentially detected by the segment detection unit, and a transmission unit that transmits information indicating the segment in which the own device exists, and information indicating a time at which the own device begins to be in the segment when the segment change determination unit has determined that the segment in which the own device exists has

changed.

Advantageous Effects of Invention

[0021]

According to the traffic information processing system, the detection device, the server device, the traffic information processing method, and the program described above, it is possible to acquire and process traffic information in units of segments.

Brief Description of Drawings

[0022]

Fig. 1 is a schematic block diagram of a traffic information processing system of a first embodiment of the present invention.

Fig. 2 is a block diagram illustrating an internal configuration of an on-board unit of the embodiment.

Fig. 3 is a diagram illustrating a table stored in a storage unit of the on-board unit of the embodiment.

Fig. 4A is a diagram illustrating an example of division of a road into segments in the embodiment.

Fig. 4B is a diagram illustrating an example of division of a road into segments in the embodiment.

Fig. 4C is a diagram illustrating an example of division of a road into segments in the embodiment.

Fig. 4D is a diagram illustrating an example of division of a road into segments in the embodiment.

Fig. 5 is a block diagram illustrating an internal

configuration of a center server device of the embodiment.

Fig. 6 is a diagram illustrating a segment table of the center server device of the embodiment.

Fig. 7 is a flowchart illustrating an operation of the on-board unit of the embodiment.

Fig. 8 is a diagram illustrating a process of a dead-reckoning processing unit of the embodiment.

Fig. 9 is a diagram illustrating a process of a map matching processing unit of the embodiment.

Fig. 10 is a diagram illustrating a structure of data stored in a segment table of the embodiment.

Fig. 11 is a flowchart illustrating an operation of the center server device of the embodiment.

Fig. 12 is a block diagram illustrating an internal configuration of an on-board unit when a travel direction determination is performed by an on-board unit in the embodiment.

Fig. 13 is a diagram illustrating a segment table when a travel direction determination is performed by an on-board unit in the embodiment.

Fig. 14A is a diagram illustrating another example in which an entrance notification point is set in the embodiment.

Fig. 14B is a diagram illustrating another example in which an entrance notification point is set in the embodiment.

Fig. 15A is a diagram illustrating a configuration of a second embodiment.

Fig. 15B is a diagram illustrating a configuration of the second embodiment.

Fig. 16 is a diagram illustrating an internal configuration of the center server device of the embodiment.

Fig. 17 is a diagram illustrating a structure of data stored in the segment table of the embodiment.

Fig. 18 is a flowchart illustrating an operation of the center server device of the embodiment.

Description of Embodiments

[0023]

[First embodiment]

Hereinafter, embodiments of the present invention will be described with reference to the drawings. Fig. 1 is a conceptual diagram illustrating a traffic information processing system 100 of a first embodiment. The traffic information processing system 100 includes on-board units 1-1, 1-2, 1-3, ... that are mounted on a plurality of vehicles 2-1, 2-2, 2-3, ... that run along a road and to which uniquely identifiable IDs (Identifier) are given, a center server device 3, a GPS (Global Positioning System) satellite 90, and a base station device 80 for a portable phone.

In this traffic information processing system 100,

the road along which the vehicles 2-1, 2-2, 2-3, ... run is divided into a plurality of sections called segments in advance, and the uniquely identifiable IDs are given to the respective segments, as segments 1, 2, 3,

Further, in the following description, a representative vehicle and a representative on-board unit are described as a vehicle 2 and an on-board unit 1, respectively. Each of the on-board units 1-1, 1-2, 1-3, ... has the same internal configuration as the internal configuration of the on-board unit 1 that will be described below. Further, connection points of segments indicated by reference numerals 70, 71, and 72 in Fig. 1 are referred to as entrance notification points.

[0024]

Fig. 2 is a block diagram illustrating the internal configuration of the on-board unit 1. The on-board unit 1 is a detection device that is mounted on the vehicle 2 for detecting various pieces of information. This on-board unit 1 includes a power supply circuit 10, a built-in battery 11, a wide area communication device 12, a position detection unit 13, a map matching processing unit 14, a road map data storage unit 15, a segment change determination unit 16, a display unit 17, a reporting unit 18, a storage unit 19, and a control unit 20. Further, the position detection unit 13 includes a GPS receiver 13-1, a GPS supplement sensor unit 13-2, and a dead-reckoning

processing unit 13-3.

In the on-board unit 1, the power supply circuit 10 includes a regulator that stabilizes a supplied voltage, and a noise protector, receives a supplied voltage of 12 V or 24 V from the vehicle 2, and supplies the supplied voltage to each unit in the on-board unit 1.

The built-in battery 11 is a backup battery, and supplies a supplied voltage to each unit so as to protect data stored inside the on-board unit 1 when the power of the vehicle 2 is lost or blocked.

The wide area communication device 12 is, for example, a portable phone terminal, and communicates with the base station device 80 via a communication network for portable phone communication, and performs transmission and reception to and from a center server device 3.

[0025]

The position detection unit 13 detects a position of the on-board unit 1 using the GPS receiver 13-1, the GPS supplement sensor unit 13-2, and the dead-reckoning processing unit 13-3.

The GPS receiver 13-1 receives electric waves from a GPS satellite 90 to read information regarding the time and measure information regarding latitude and longitude from received data.

The GPS supplement sensor unit 13-2 includes a gyro sensor and an acceleration sensor, and performs an

operation of estimating the position of the on-board unit 1 from information regarding the gyro sensor and the acceleration sensor. Further, the GPS supplement sensor unit 13-2 may be, for example, a constituent unit used for a case in which reception sensitivity of the electric waves from the GPS satellite 90 is not preferable.

The dead-reckoning processing unit 13-3 performs an operation of supplementing the position of the on-board unit 1 based on the information regarding the latitude and the longitude measured by the GPS receiver 13-1 and the information regarding the position of the on-board unit 1 estimated by the GPS supplement sensor unit 13-2 according to the precision of the information included in the electric waves received by the GPS receiver 13-1.

[0026]

The map matching processing unit 14 matches information regarding the position of the segment stored in the road map data storage unit 15 with the information regarding the position of the on-board unit 1 detected by the position detection unit 13, and detects the segment in which the on-board unit 1 exists. That is, the map matching processing unit 14 is an example of a constituent unit functioning as a segment detection unit that detects the segment correlating with the position detected by the position detection unit 13 from among the plurality of segments which are sections obtained by dividing the road.

[0027]

The segment change determination unit 16 determines, for example, whether the on-board unit 1 has passed the entrance notification points 70 to 72 and entered a new segment based on the result of a detection process of the map matching processing unit 14. Further, for example, when the segment change determination unit 16 determines that the on-board unit 1 has passed any one of the entrance notification points 70 to 72, the segment change determination unit 16 transmits information in which the ID of the segment that the vehicle has newly entered, information on the time, and the on-board unit ID are associated with the center server device 3 via the wide area communication device 12. In other words, the wide area communication device 12 is an example of a constituent unit functioning as a transmission unit that transmits information in which information indicating the segment in which the own on-board unit 1 exists (in other words, the segment after the change or the segment that the vehicle has newly entered), and information indicating a time at which the own on-board unit 1 begins to be in the segment are associated, to the center server device 3 when the segment change determination unit 16 has determined that the segment which the own on-board unit 1 exists has changed.

[0028]

The display unit 17 displays, for example, information indicating a state or a position on the map of the on-board unit 1, and a degree of congestion of the road received from the center server device 3.

The reporting unit 18 includes a built-in speaker, and notifies a driver of the vehicle 2 of information through a buzzer or a melody.

The storage unit 19 stores programs or data used in the on-board unit 1. This storage unit 19 has a table that stores information regarding latitude and longitude detected by the position detection unit 13, and a segment ID obtained as a result of matching in the map matching processing unit 14, in association with information regarding time included in electric waves from the GPS satellite 90, for example, as illustrated in Fig. 3. Further, in the table, no record in the segment ID (item with "-") indicates that the corresponding segment has not been detected in the map matching processing unit 14.

[0029]

The control unit 20 performs general management including transmission and reception of data of each unit of the on-board unit 1. When the on-board unit 1 also serves, for example, as a car navigation system, this control unit 20 also performs a process for path induction to a destination in the car navigation system, or a process of selecting an optimal path to the destination

based on the information indicating the degree of congestion received from the center server device 3.

[0030]

The road map data storage unit 15 stores the map data of the road in the form of the segments described above, and, for example, information regarding the latitude and the longitude of the start point and the end point of each segment, in which the information indicating a connection relationship of the respective segments is included. Further, in the present embodiment, all roads are not divided into segments and shown, but roads on which the degree of congestion is desired to be detected are assumed to be stored in the segment form.

A scheme of dividing the road into the segments includes, for example, a scheme for accurately estimating the degree of congestion in a road, as illustrated in Figs. 4A to 4D.

A general scheme is a scheme of dividing a road into one segment from a branch point to another branch point, as illustrated in Fig. 4A.

On the other hand, a division scheme in Fig. 4B is a scheme of dividing a long straight line into a plurality of segments at certain distances, in addition to the division at the branch point. Accordingly, it is possible to detect a congesting place even in the straight road.

[0031]

Figs. 4C and 4D illustrate a scheme of dividing a curved road into segments.

A scheme of approximating and dividing the curved road to and into two straight lines as illustrated in Fig. 4C may be applied, and a scheme of approximating the curved road to a plurality of short straight lines as illustrated in Fig. 4D may be applied.

In the case of Fig. 4D, each of the plurality of short straight lines of the curved portion may be a segment, the plurality of short straight lines may be connected at nodes, and a connected portion may be one segment. In this case, information regarding the latitude and the longitude of each node may be stored in association with each other.

In the scheme as illustrated in Fig. 4D, an error between the position detected by the position detection unit 13 and the position of the segment becomes small, and it is possible to increase the precision of matching in the map matching processing unit 14. Further, in the division illustrated in Fig. 4D, it is possible to accurately detect the degree of congestion of a point joining to the straight road, unlike in the division as illustrated in Fig. 4C.

Further, the data stored in the road map data storage unit 15 is updated by the control unit 20 downloading latest data from the center server device 3

via the wide area communication device 12.

[0032]

Fig. 5 is a block diagram illustrating the internal configuration of the center server device 3.

This center server device 3 includes a road map data storage unit 30, a storage unit 31, an Internet communication unit 32, a segment table 33, a traffic information detection unit 34, a travel direction determination unit 35, a control unit 36, and a traffic information providing unit 37.

The road map data storage unit 30 stores the same data as the data stored in the road map data storage unit 15 of the on-board unit 1 described above. Further, the latest data is stored in the road map data storage unit 30, and the on-board unit 1 downloads the data stored in the road map data storage unit 30 and updates the data of the road map data storage unit 15, as described above.

The storage unit 31 stores programs or data used for control of the center server device 3.

The Internet communication unit 32 is connected to the base station device 80 via an Internet network, and performs transmission and reception to and from each on-board unit 1. This Internet communication unit 32 is, for example, an example of a constituent unit functioning as reception unit that receives information in which information indicating the segment and information

indicating the time are associated, from each on-board unit 1.

The segment table 33 is, for example, a table having a format illustrated in Fig. 6, and stores data that the Internet communication unit 22 receives from the respective on-board units 1-1, 1-2, 1-3, ... This segment table 33 first includes an item of the on-board unit ID, and includes a plurality of sets of items of time and Seg (segment).

The traffic information detection unit 34 detects the information indicating the traffic state of the road based on the information stored in the segment table 33.

The travel direction determination unit 35 determines a travel direction of the vehicle 2 based on the information stored in the segment table 33.

The control unit 36 performs general management including transmission and reception of the data of each unit of the center server device 3.

The traffic information providing unit 37 transmits the information indicating the traffic state detected by the traffic information detection unit 34 to the on-board unit 1 via the Internet communication unit 22.

[0033]

Next, a processing operation of the on-board unit 1 will be described with reference to a flowchart in Fig. 7.

(Step ST101)

For example, in Fig. 1, the vehicle 2-1 is assumed to enter segment 1 in a state in which the vehicle 2-1 runs in an area to which a segment is not assigned in a road leading to segment 1. The GPS receiver 13-1 of the on-board unit 1-1 of this vehicle 2-1 receives electric waves at a constant period from the GPS satellite 90. This GPS receiver 13-1 measures latitude and longitude from information included in the received electric waves, and outputs information regarding the latitude and the longitude, time information included in the received electric waves, and information indicating reliability of the information included in the received electric waves. Further, in this embodiment, GPS receiver 13-1 outputs information in which information indicating that a position of the on-board unit 1-1 is a point P1 (latitude ϕ_1 , longitude λ_1), information indicating that a time at which the position has been detected is "9:56" and information indicating reliability "high" are associated.

[0034]

(Step ST102)

Then, the GPS supplement sensor unit 13-2 of the on-board unit 1-1 performs an operation of estimating a position in which the on-board unit 1-1 exists at the time "9:56" output by the GPS receiver 13-1 based on information regarding a direction of rotation of the vehicle 2-1 obtained from the gyro sensor and a speed of

the vehicle 2-1 obtained from the acceleration sensor. In this embodiment, the GPS supplement sensor unit 13-2 is assumed to have obtained information indicating a point P2 (latitude ϕ_2 , longitude λ_2) that is the position of the on-board unit 1-1 as a result of the operation.

Also, the dead-reckoning processing unit 13-3 calculates the position of the on-board unit 1-1 through the scheme illustrated in Fig. 8 using the information regarding the two positions obtained from the GPS receiver 13-1 and the GPS supplement sensor unit 13-2.

Specifically, the position of the on-board unit 1-1 estimated through the operation by the GPS supplement sensor unit 13-2 is a position indicated by the point P2 (latitude ϕ_2 , longitude λ_2), and the position based on the information regarding the latitude and the longitude output by the GPS receiver 13-1 is a position indicated by the point P1 (latitude ϕ_1 , longitude λ_1). In this case, the dead-reckoning processing unit 13-3 calculates a position of a point P3 (latitude ϕ_3 , longitude λ_3) as a position of the on-board unit 1-1 through an operation of weighted averaging using the reliability of the information output by the GPS receiver 13-1 as a weight. That is, as the reliability of the information output by the GPS receiver 13-1 becomes higher, the position of the point P3 (latitude ϕ_3 , longitude λ_3) is closer to the position of the point P1 (latitude ϕ_1 , longitude λ_1) output

by the GPS receiver 13-1.

This dead-reckoning processing unit 13-3 stores information regarding the calculated position (that is, information indicating the point P3 (latitude ϕ_3 , longitude λ_3)) and information regarding the time "9:56" output by the GPS receiver 13-1 so as to be associated with each other in a table of the storage unit 19 illustrated in Fig. 3, and outputs the information to the map matching processing unit 14. Further, the position that is a start point when the GPS supplement sensor unit 13-2 performs the operation of estimating the position is a position indicated by the point P3 (latitude ϕ_3 , longitude λ_3). In the example illustrated in Fig. 3, the point P3 is a position indicated by the latitude $\phi_3 = +35.25.33.135$ and the longitude $\lambda_3 = +139.40.20.234$.

[0035]

(Step ST103)

Then, the map matching processing unit 14 receives the point P3 (latitude ϕ_3 , longitude λ_3) which is the information regarding the position and the information regarding the time "9:56" from the dead-reckoning processing unit 13-3, reads the past information regarding the position of the on-board unit 1-1 and the time information associated with the information regarding the position stored in the table of the storage unit 19, and obtains the trajectory of the vehicle 2-1, that is, the

trajectory of the on-board unit 1-1 arranged in time-series.

For example, the trajectory of the on-board unit 1-1 is assumed to be a trajectory I as illustrated by a dotted line in Fig. 9. The map matching processing unit 14 extracts three paths of path candidates C1, C2, and C3 from the data stored in the road map data storage unit 15 as candidates of paths corresponding to the obtained trajectory I based on the this trajectory I. Also, the map matching processing unit 14 determines the candidate path having a smallest amount of error based on the areas of regions (hatched regions in Fig. 9) surrounded by the obtained trajectory I and the respective paths of path candidates C1, C2, and C3. In this embodiment, the map matching processing unit 14 determines the candidate path C2 in which the area of the region surrounded by the trajectory I and the path candidate (the hatched region in Fig. 9) is smallest, as a path corresponding to the trajectory I of the on-board unit 1-1.

[0036]

Also, the map matching processing unit 14 matches the path C2 determined to be a path of the trajectory I with the information regarding the latest position, and detects the segment in which the on-board unit 1-1 exists.

This map matching processing unit 14 records the segment ID of the detected segment to be associated with

the information regarding the position and the time of the storage unit 19 based on the information regarding the time correlating with the segment ID, and outputs the segment ID to the segment change determination unit 16.

In this embodiment, the point P3 (latitude ϕ_3 , longitude λ_3) is assumed to be a position included in the area corresponding to segment 1. In this case, the map matching processing unit 14 determines that the on-board unit 1-1 has entered segment 1 at the time "9:56". Also, the map matching processing unit 14 writes "1" to an item Seg (segment) correlating with the time "9:56". Further, when the segment ID is unable to be detected, the map matching processing unit 14 writes "-" to the item Seg of the table of the storage unit 19, as described above.

[0037]

(Step ST104)

Then, the segment change determination unit 16 receives segment ID "1" and information regarding the time "9:56" from the map matching processing unit 14, reads information regarding the segment ID at an immediately previous time from the table of the storage unit 19, and determines whether the segment ID has changed.

Here, since the vehicle 2-1 runs along the area to which no segment is assigned and enters segment 1, "-" indicating that there is no segment ID is recorded in the item Seg correlating with an immediately previous time

("9:55" in Fig. 3). When the segment ID is newly detected in a state in which no segment ID is recorded and when a value different from the segment ID at the target time is recorded in the segment ID for the immediately previous time, the segment change determination unit 16 determines that the segment ID has changed.

On the other hand, when the ID of the segment from the map matching processing unit 14 and the segment ID at an immediately previous time are the same, the segment change determination unit 16 determines that no change has occurred and returns to the process of step ST101.

[0038]

(Step ST105)

Also, when the segment change determination unit 16 determines that the segment ID has changed, the segment change determination unit 16 transmits the segment ID "1", the information regarding the time "9:56" correlating with the segment ID "1", and the on-board unit ID "12340001" which are received from the map matching processing unit 14, to the center server device 3 via the wide area communication device 12.

When the control unit 36 of the center server device 3 receives the data from the on-board unit 1-1 via the Internet communication unit 32, the control unit 36 writes and stores the received data to and in the segment table 33, as illustrated in Fig. 6. Here, the on-board unit 1-1

correlates with the on-board unit ID "12340001", "9:56" is written to an item time 1 in a row of the on-board unit ID "12340001", and "1" indicating segment 1 is written to a corresponding item Seg.

[0039]

As illustrated in Fig. 1, as the vehicle 2-1 moves, the on-board unit 1-1 writes data to the table of the storage unit 19 each time the on-board unit 1-1 measures the position. Also, when the segment change determination unit 16 determines that the segment ID has changed, the on-board unit 1-1 transmits the data to the center server device 3, and the data is written to the segment table 33 of the center server device 3.

Thus, when the on-board unit 1-1 moves, for example, in order of segments 1, 2, 4, and 6, the segment ID at an immediately previous time and the segment ID at a target time change.

In this case, in step ST104, the segment change determination unit 16 determines that the segment has changed, and transmits information in which the segment ID, the information regarding the time correlating with the segment ID, and the on-board unit ID "12340001" received from the map matching processing unit 14 are associated to the center server device 3. The center server device 3 writes the received information to the segment table 33. Specifically, the center server device 3 records data as

shown in the row of the on-board unit ID "12340001" in Fig. 6 in the segment table 33.

[0040]

Then, when the vehicle 2-1 exits segment 6, the map matching processing unit 14 is unable to detect the corresponding segment ID in the process of step ST103. Therefore, the map matching processing unit 14 writes "-" to indicate that there is no corresponding segment ID, as shown in the item Seg correlating with the item time "10:53" in the storage unit 19 of the on-board unit 1-1.

When the state changes from a state in which the segment ID exists to a state in which no corresponding segment ID in step ST104 exists, the segment change determination unit 16 determines that the segment has changed, and transmits data to the center server device 3. The center server device 3 writes a state ("-") in which there is no corresponding segment ID to the segment table 33, as shown in the item Seg of time 5 in Fig. 6. When "-" is written to the item Seg of the segment table 33, this indicates that the on-board unit 1-1 has exited the segment in which the on-board unit 1-1 exists until an immediately previous time.

Thus, when the segment change determination unit 16 determines that the segment ID has changed, the on-board unit 1-1 according to this embodiment transmits the segment ID of the segment in which the on-board unit 1-1

exists, and the time at which the on-board unit 1-1 begins to be in the segment indicated by this segment ID to the center server device 3 to be associated with each other. Accordingly, it is possible to reduce the number of transmissions in comparison with a case in which the time and the positional information as illustrated in Fig. 3 are all transmitted to the center server device 3.

[0041]

[Operation of the center server device]

Next, an operation of the traffic information detection unit 34 of the center server device 3 will be described with reference to Figs. 10 and 11.

When the plurality of the vehicles 2-1, 2-2, 2-3, ... run along the road divided into segments, data from the plurality of the on-board units 1-1, 1-2, 1-3, ... is stored in the segment table 33 illustrated in Fig. 6.

Fig. 10 is a diagram illustrating data stored in the segment table 33 to be visually easily understood. For example, in Fig. 10, the on-board unit 1-1 having on-board unit ID "12340001" enters segment 1 at 9:56, enters segment 2 at 10:04, enters segment 4 at 10:16, enters segment 6 at 10:36, and exits segment 6 at 10:53.

[0042]

Fig. 11 is a flowchart illustrating an example of the process flow in the traffic information processing system 100 according to this embodiment.

(Step ST201)

The traffic information detection unit 34 selects a first detection target time in order to detect the number of the vehicles 2 that are present in any one of the segments at a predetermined time from this segment table 33. It is assumed that the traffic information detection unit 34 selects, for example, a time "10:30".

(Step ST202)

Then, the traffic information detection unit 34 selects a target segment. Here, it is assumed that the traffic information detection unit 34 selects segment 4. Further, an operator of the center server device 3 may arbitrarily select and set the time and the segment or may select a predetermined time, such as a time of every 30 minutes beginning at 0:00. Further, for the segments, all segments may be sequentially selected one by one from segment 1.

(Step ST203)

The traffic information detection unit 34 reads, for each on-board unit 1, the segment ID associated with the selected time "10:30" from the segment table 33. Further, the traffic information detection unit 34 may read, for each on-board unit 1, the segment ID associated with a time of "10:25 to 10:35" that is a period of time within five minutes before and after the selected time "10:30" from the segment table 33. Further, the traffic

information detection unit 34 may read, for each on-board unit 1, the time of "10:25 to 10:35" that is a period of time within five minutes before and after the selected time "10:30" associated with the selected segment ID 4 from the segment table 33.

[0043]

(Step ST204)

Also, the traffic information detection unit 34 determines, for each on-board unit 1, whether the on-board unit 1 exists in the selected segment 4 at the selected time "10:30" (or within five minutes before and after the selected time "10:30") based on the read information.

The on-board unit 1-1 having on-board unit ID "12340001" exists in segment 4 at the time "10:30", as shown in the segment table 33. Therefore, the traffic information detection unit 34 determines that the on-board unit 1-1 having on-board unit ID "12340001" exists in the selected segment 4 at the selected time "10:30".

[0044]

(Step ST205)

When the traffic information detection unit 34 determines that the target on-board unit 1-1 exists in segment 4 at the time "10:30", the traffic information detection unit 34 outputs on-board unit ID "12340001" of the target on-board unit 1-1 and the selected segment ID "4" to the travel direction determination unit 35.

Also, the travel direction determination unit 35 reads data corresponding to the on-board unit ID "12340001" output by the traffic information detection unit 34 from the segment table 33. This travel direction determination unit 35 detects the item corresponding to segment ID "4" output by the traffic information detection unit 34 from the read data, and reads the segment ID at the immediately previous time in the detected item. In the example illustrated in Fig. 6, the travel direction determination unit 35 reads segment ID = 2 at the immediately previous time "10:04" in the item of the detected segment ID "4".

Then, the travel direction determination unit 35 determines a travel direction of the vehicle 2-1 based on data indicating the connection relationship between the segments stored in the road map data storage unit 30. Here, the travel direction determination unit 35 detects a path on which the segment ID changes in order from 2 to 4 from the road map data storage unit 30, and determines that this detected path is an up lane. Also, the travel direction determination unit 35 outputs a determination result "up lane" together with on-board unit ID "12340001" to the traffic information detection unit 34.

[0045]

(Step ST206)

On the other hand, when the traffic information

detection unit 34 determines that there is no target on-board unit 1-1 in segment 4 at the time "10:30", the traffic information detection unit 34 proceeds to the process of step ST206. This traffic information detection unit 34 determines whether data of all the on-board units 1-1, 1-2, 1-3, ... has been read. When the data of all the on-board units 1-1, 1-2, 1-3, ... is not read, the traffic information detection unit 34 repeats the process of steps ST203 to ST205.

(Step ST207)

On the other hand, when the data of all the on-board units 1-1, 1-2, 1-3, ..., is read, the travel direction determination unit 35 outputs each determination result together with on-board unit ID to the traffic information providing unit 37.

[0046]

In the example illustrated in Fig. 10, there are five on-board unit IDs 12340001, 12340008, 12340015, 12340003, and 12340030 in segment 4, and the travel direction determination unit 35 outputs a determination result indicating that the respective on-board unit IDs are an up lane, a down lane, a down lane, an up lane, and a down lane. Accordingly, the traffic information providing unit 37 can transmit a value indicating the number of vehicles 2 present in segment 4 at the time 10:30 to each vehicle 2 as information indicating the

degree of congestion of segment 4 at the corresponding time based on the determination result input from the travel direction determination unit 35. Further, the traffic information providing unit 37 becomes able to transmit the information indicating the degree of congestion of each of the up lane and the down lane to each vehicle 2.

Further, when there is no item at the immediately previous time in the determination of the travel direction determination unit 35, and for example, when segment 1 is selected as a target segment, there is no item of the immediately previous time, for the on-board unit 1-1 having on-board unit ID = 12340001, as illustrated in Fig. 6. In such a case, when the vehicle enters segment 1 in a state in which there is no segment ID, an indication of the up lane is stored in the road map data storage unit 30, and thus, it is possible to cause the travel direction determination unit 35 to determine the direction.

[0047]

In the first embodiment described above, the configuration in which each on-board unit 1 performs detection of the position, detects the segment in which the on-board unit 1 exits based on the detected position, and transmits the segment ID of the segment that the on-board unit 1 newly enters to the center server device 3 when the segment in which the on-board unit 1 exits is

changed is applied. Accordingly, the center server device 3 can perform detection of the number of vehicles 2 at a certain time in units of segments and collect the information indicating the degree of congestion in the segment.

Further, it is possible to obtain a merit that detailed path guidance according to each traffic situation can be performed when the traffic information is provided, in comparison with a case in which the traffic information in each grid is acquired.

Further, it is possible to provide the information indicating the degree of congestion for each of the up lane and the down lane to the vehicle 2 by applying the configuration in which the information indicating the connection relationship among the segments is stored in the road map data storage unit 15, and the determination of the travel direction is performed using this information in the center server device 3. Further, since the data is transmitted from the on-board unit 1 to the center server device 3 only when the segment has been changed, it is possible to reduce an amount of transmission to the center server device 3 and to reduce a processing load.

[0048]

Further, while the travel direction determination unit 35 is included in the center server device 3 in the

first embodiment described above, the travel direction determination unit 21 may be included in the on-board unit. For example, an on-board unit 1a in which the travel direction determination unit 21 is newly added as functional block as illustrated in Fig. 12 is configured. In this configuration, the process of Fig. 7 described above is as follows.

In the on-board unit 1a, when the segment change determination unit 16 determines that the segment has changed (Yes in step ST204), the segment change determination unit 16 outputs a target segment ID to the travel direction determination unit 21. The travel direction determination unit 21 reads an item corresponding to the segment ID output by the segment change determination unit 16 from the table of the storage unit 19, and detects the segment ID at the immediately previous time of the read item. Since the segment change determination unit 16 determines that the segment has changed, the segment ID recorded at the immediately previous time is a segment ID different from the segment ID that is a processing target.

The travel direction determination unit 21 determines the travel direction based on the target segment ID and the segment ID at an immediately previous time, and the data stored in the road map data storage unit 15, and outputs a result of the determination to the

segment change determination unit 16. The segment change determination unit 16 transmits the time, the segment ID, the information indicating the travel direction (for example, up: up lane or down: down lane), and the on-board unit ID to the center server device 3.

[0049]

The control unit 36 of the center server device 3 writes the data received from the on-board unit 1a to the segment table 33. Fig. 13 illustrates an example of a structure of the segment table to which the travel direction has been written, and information indicating the up lane or the down lane together with the segment ID is written to an item Seg (segment).

Through this configuration, when the traffic information detection unit 34 of the center server device 3 reads the segment ID from the segment table 33 without performing the process of step ST205 in Fig. 11, the traffic information detection unit 34 can read the information indicating the up lane or the down lane, and it is possible to reduce the process in the center server device 3.

[0050]

Further, in the process described above, when the travel direction determination unit 21 reads the segment ID at the immediately previous time from the table of the storage unit 19, the travel direction determination unit

21 may read the information ("-") indicating that there is no segment ID. Even when the travel direction determination unit 21 reads this information, if there is a change into a certain segment ID in a state in which there is no segment ID, an indication indicating whether this indicates the up lane or the down lane is stored in the road map data storage unit 15 as information in advance, and thus, a determination as to whether the path is the up lane or the down lane can be performed.

Further, when the travel direction determination unit is included in the on-board unit, the information indicating the direction in which the vehicle 2 runs is obtained by the GPS supplement sensor unit 13-2 in the on-board unit 1a, and thus, when the determination as to whether the path is an up lane or a down lane is performed by the travel direction determination unit 21, it is possible to perform a check as to whether the determined direction is accurate based on the information regarding the direction obtained from the GPS supplement sensor unit 13-2 and also to increase precision.

[0051]

Further, in the configuration of the first embodiment described above, a time at which the vehicle 2 has passed the entrance notification points 70, 71, and 72 of Fig. 1, which are branch points of the segment, has been used as a timing at which the segment change

determination unit 16 determines that the segment ID has changed. On the other hand, in an actual environment, for example, in a city area with many high-rise buildings, since GPS reception sensitivity decreases, it may be difficult to accurately determine whether the vehicle 2-1 proceeds to segment 3 or to segment 4 when the vehicle 2-1 passes a branch point of segment 2, segment 3, and segment 4, as illustrated in Fig. 14A.

For example, actually, even when the vehicle goes straight from segment 2 to segment 4, segment 3 may be detected in a state in which segment 2 is detected depending on sensitivity of the electric waves, and then segment 4 may be detected.

In this case, in a scheme of increasing precision of the determination, for example, as illustrated in Fig. 14B, a point P1 or P2 slightly away from the branch point may be an entrance notification point, and the map matching processing unit 14 may select whether a new segment ID is to be output based on whether the position of the on-board unit 1a has been beyond such points.

For example, when the vehicle 2-1 has gone straight from segment 2 to segment 4, the map matching processing unit 14 outputs segment 2 until the vehicle is beyond a point of P1, and outputs segment 4 when the vehicle has been beyond the point of P1. In this configuration, it is possible to accurately perform the determination of the

segment change without changing the process of the segment change determination unit 16.

[0052]

Further, in addition to the above-described scheme, there is a scheme of changing a timing of the determination in the segment change determination unit 16. For example, the segment change determination unit 16 determines that the segment ID has changed, and then may also use a result of the determined change after a certain time lapses. This certain time is a time until the detection of the segment in the map matching processing unit 14 is stabilized, such as a time until the same segment ID is continuously detected.

Further, the segment change determination unit 16 determines that the segment ID has changed, and then may also determine that the segment ID has changed when the same segment ID is output from the map matching processing unit 14 continuously multiple times or more.

In any of the schemes, for the time, it is necessary to return to the time at which the vehicle 2 passes the branch point, and, in the map matching processing unit 14, the distance from the branch point is obtained when the entrance notification point is changed. Thus, a speed at which the vehicle passes P1 or P2 is acquired from the GPS supplement sensor unit 13-2, and the time at which the vehicle passes the branch point can be obtained through a

reverse operation.

Further, when the segment change determination unit 16 performs a process of increasing the precision, the segment change determination unit 16 stores a time at which the segment ID is first determined to have been changed, and thus, this time can be regarded as a time at which the vehicle has passed the branch point.

Through the configuration as described above, it is possible to accurately detect a change in the segment even in an area in which GPS reception sensitivity is low.

[0053]

[Second embodiment]

The center server device 3 of the first embodiment includes the configuration in which the number of vehicles that are in the segment at a certain time is detected, and a process of indicating the degree of congestion of the segment is performed. This configuration indicates the degree of congestion close to an actual state of the segment when many vehicles 2 have on-board units 1 mounted thereon. In a situation in which the on-board unit 1 has not so much widespread and, for example, when the number of vehicles M1, M2, and M3 not having the on-board unit 1 mounted thereon is greater than the number of vehicles 2-2 having the on-board unit 1 mounted thereon, an accurate degree of congestion in segment 2 is not indicated by detection of only the vehicle 2-2 having the on-board unit

1-2 mounted thereon.

On the other hand, a center server device 3 of the second embodiment has a configuration in which an amount of passage time necessary for passage of the vehicle 2 in a certain segment or an average speed during running in the segment are calculated as information indicating the degree of congestion instead of using the number of vehicles 2 in the segment as the degree of congestion, as illustrated in Fig. 15B.

[0054]

Fig. 16 is a block diagram illustrating an internal configuration of a center server device 3a of the second embodiment. In the center server device 3a of the second embodiment, the same configurations as those in the center server device 3 of the first embodiment are denoted with the same reference signs, and a traffic information detection unit 34a that is a different configuration will be hereinafter described. Fig. 17 is a diagram illustrating information stored in a segment table 33 to be visually easily understood. Hereinafter, an operation of the center server device 3a of the second embodiment will be described with reference to a flowchart of Fig. 18.

[0055]

(Step ST301)

First, the traffic information detection unit 34a of the center server device 3a selects a target time to

detect the vehicle 2 which has passed any one of segments at a predetermined time.

Here, 10:40 is assumed to be selected.

(Step ST302)

Then, the traffic information detection unit 34a selects a target segment. Here, segment 4 is assumed to be selected.

Similarly to the first embodiment, an operator of the center server device 3a may arbitrarily select and set the time and the segment or may select a predetermined time, such as a time of every 30 minutes beginning with 0:00. Further, for the segments, all segments may be sequentially selected one by one from segment 1.

(Step ST303)

The traffic information detection unit 34a reads data for each on-board unit 1 from the segment table 33.

(Step ST304)

Then, the traffic information detection unit 34 determines whether the on-board unit 1 has passed the selected segment at the selected time based on the read data.

Since the on-board unit 1 having the first read on-board unit ID = 12340001 has passed segment 4 at 10:40, the traffic information detection unit 34 determines that the on-board unit 1 has passed. On the other hand, when it is determined that the target on-board unit 1 has not

passed segment 4 at 10:40, the traffic information detection unit 34a proceeds to the process of step ST307.

[0056]

(Step ST305)

When the traffic information detection unit 34a determines that the target on-board unit 1 has passed segment 4 at 10:40, the traffic information detection unit 34a outputs the on-board unit ID of the target on-board unit 1 and the selected segment ID to the travel direction determination unit 35. The travel direction determination unit 35 performs a determination as to whether the path is an up lane or a down lane through the same process as in the first embodiment. Here, since the travel direction determination unit 35 reads a segment ID at an immediately previous time of the item in which the segment ID is 4, the travel direction determination unit 35 reads "2". The travel direction determination unit 35 detects a path in which the segment ID is changed in order from 2 to 4 from the road map data storage unit 30, determines that the path is the up lane, and outputs a determination result together with the on-board unit ID to the traffic information detection unit 34a.

(Step ST306)

Then, the traffic information detection unit 34a detects the time at which the target on-board unit 1 has entered segment 4 and the time at which the target on-

board unit 1 has exited segment 4 from the segment table 33. The time at which the target on-board unit 1 has exited segment 4 is the time at which the target on-board unit 1 has entered segment 6. The traffic information detection unit 34a calculates a distance of segment 4 based on the latitude and the longitude of the start point and the end point of segment 4 stored in the road map data storage unit 30, and calculates an amount of passage time and an average speed based on the calculated distance, and the detected entrance and exit time.

Further, it is possible to reduce a load of an operation process in the traffic information detection unit 34a by storing information indicating the distance of each segment in the road map data storage unit 30 in advance.

(Step ST307)

The traffic information detection unit 34a determines whether data of all the on-board units 1 has been read. When the data of all the on-board units 1 has not been read, the traffic information detection unit 34a repeats the process from step ST303.

(Step ST308)

On the other hand, when the data of all the on-board units 1 has been read, the traffic information detection unit 34a outputs a result to the traffic information providing unit 37.

[0057]

In the example illustrated in Fig. 17, since three on-board units having on-board unit IDs 12340001, 12340008, and 12340015 have passed segment 4, the traffic information providing unit 37 can provide the amount of passage time of segment 4 and the average speed obtained using the data of the three on-board units 1. Further, the on-board units having the on-board unit IDs 12340008 and 12340015 pass the down lane of segment 4, and values obtained by further averaging the amount of passage time and the average speed obtained from the two on-board units 1 may be provided.

[0058]

Through the configuration of the second embodiment described above, the center server device 3a can read the data of the vehicle 2 that has passed a certain segment from the data stored in the segment table 33 and calculate the amount of passage time and the average speed in the segment. Accordingly, even when there are a small number of vehicles 2 on which the on-board unit 1 is not mounted, it is possible to calculate the amount of passage time and the average speed in the segment of the vehicles on which the on-board unit 1 is mounted, and to provide this information as information indicating the degree of congestion.

[0059]

Further, in the second embodiment described above, a configuration in which the travel direction determination unit described with reference to Figs. 12 and 13 is included in the on-board unit may be applied. When such a configuration is applied, the center server device 3a does not have to perform the process of step ST305 in Fig. 18, and can obtain the information indicating whether the path is the up lane or the down lane when reading the data from the segment table 33 in step ST303.

[0060]

Further, in the first and second embodiments described above, when the determination of the travel direction is performed by the travel direction determination unit 35, information indicating the travel direction of the vehicle on the road such as one-way transit is stored in the road map data storage unit 30, and thus, it is possible to perform a check as to whether or not a result of determining the travel direction is correct. This applies to the configuration in which the travel direction determination unit 21 described with reference to Fig. 12 is included in the on-board unit and, by storing the same information in the road map data storage unit 15, it is possible to perform a check as to whether the result of determining the travel direction is correct.

[0061]

Further, while in the first and second embodiments described above, the map matching processing unit 14 causes "-" indicating that there is no segment ID to be stored in the storage unit 19 or the segment table 33 when there is no corresponding segment ID, for example, a special segment ID such as segment 0 which is not assigned to an actual road may be given as one segment to an area in which no segment is assigned to, and may be processed as a change in the segment ID in the process of the segment change determination unit 16 or the travel direction determination units 35 and 21. In this case, it is necessary for information indicating a positional relationship between segment 0 and another segment ID, such as a positional relationship in which movement from segment 0 to segment 1 in Fig. 1 is an up lane and movement from segment 0 to segment 6 is a down lane to be stored in the road map data storage units 15 and 30.

[0062]

Further, while the on-board units 1 and 1a can be applied to a terminal device of a car navigation system as described above, the on-board units 1 and 1a may be included in an on-board unit of ETC (Electronic Toll Collection System) (registered trademark), or may be included in a vehicle-mounted sensor of a probe car used for collection of vehicle information. Further, the on-board units 1 and 1a may be applied to a portable phone

terminal including a GPS.

[0063]

Further, conversion of an assembly program may be performed by recording a program for realizing the functions of the respective processing units in the present invention on a computer-readable recording medium, loading the program recorded on the recording medium to a computer system, and executing the program.

Further, the "computer system" referred to herein includes an OS or hardware such as a peripheral device. Further, the "computer system" also includes a WWW system including a homepage providing environment (or display environment). Further, the "computer-readable recording medium" includes a flexible disk, a magnetic optical disc, a ROM, a portable medium such as a CD-ROM, or a storage device such as a hard disk built in the computer system. Further, the "computer-readable recording medium" also includes a recording medium that holds a program for a certain period of time, such as a volatile memory (RAM) inside a computer system including a server and a client when a program is transmitted via a network such as the Internet or a communication line such as a telephone line.

[0064]

Further, the above-described program may be transmitted from a computer in which the program is stored in a storage device or the like to other computers via a

transmission medium or by transmission waves in the transmission medium. Here, the "transmission medium" for transmitting the program refers to a medium having a function of transmitting information, such as a network (communication network) such as the Internet or a communication line such as a telephone line. Also, the above-described program may be a program for realizing some of the above-described functions. Alternatively, the program may be a program capable of realizing the above-described functions through a combination with a program previously stored in a computer system, that is, a differential file (a differential program).

Industrial Applicability

[0065]

According to the traffic information processing system, the detection device, the server device, the traffic information processing method, and the program described above, it is possible to acquire and process the traffic information in units of segments.

Reference Signs List

[0066]

- 1 VEHICLE-MOUNTED INSTRUMENT
- 10 POWER SUPPLY CIRCUIT
- 11 BUILT-IN BATTERY
- 12 WIDE AREA COMMUNICATION DEVICE
- 13 POSITION DETECTION UNIT

13-1 GPS RECEIVER
13-2 GPS SUPPLEMENT SENSOR UNIT
13-3 DEAD-RECKONING PROCESSING UNIT
14 MAP MATCHING PROCESSING UNIT
15 ROAD MAP DATA STORAGE UNIT
16 SEGMENT CHANGE DETERMINATION UNIT
17 DISPLAY UNIT
18 REPORTING UNIT
19 STORAGE UNIT
20 CONTROL UNIT
3 CENTER SERVER DEVICE
30 ROAD MAP DATA STORAGE UNIT
31 STORAGE UNIT
32 INTERNET COMMUNICATION UNIT
33 SEGMENT TABLE
34 TRAFFIC INFORMATION DETECTION UNIT
35 TRAVEL DIRECTION DETERMINATION UNIT
36 CONTROL UNIT
37 TRAFFIC INFORMATION PROVIDING UNIT

Claims

[Claim 1]

A traffic information processing system comprising a detection device mounted on a vehicle, and a server device, wherein the detection device includes:

a position detection unit that detects a position of the own device and acquires a time at which the position is detected;

a segment detection unit that detects a segment correlating with the position detected by the position detection unit from a plurality of segments that are sections into which a road is divided;

a segment change determination unit that determines whether the segment in which the own device exists has changed based on the segments sequentially detected by the segment detection unit; and

a transmission unit that transmits information indicating the segment in which the own device exists, and information indicating a time at which the own device begins to be in the segment to the server device when the segment change determination unit has determined that the segment in which the own device exists has changed, and

the server device includes

a reception unit that receives the information indicating the segment and the information indicating the time from the detection device.

[Claim 2]

The traffic information processing system according to claim 1,

wherein the detection device or the server device includes

a travel direction determination unit that determines a travel direction of the vehicle in the segment based on the segment sequentially detected by the segment detection unit and information indicating a predetermined connection relationship between segments.

[Claim 3]

The traffic information processing system according to claim 1 or 2,

wherein the server device includes

a traffic information detection unit that calculates the number of vehicles that are in the segment at an arbitrarily determined time based on the information indicating the segment and the information indicating the time.

[Claim 4]

The traffic information processing system according to any one of claims 1 to 3,

wherein the server device calculates an amount of passage time for the segment or an average speed of the vehicle that has passed the segment at an arbitrarily determined time based on the information indicating the

segment and the information indicating the time.

[Claim 5]

The traffic information processing system according to any one of claims 1 to 4,

wherein the detection device includes

an acceleration sensor that detects a speed of the vehicle, and

when the vehicle exits the first segment and enters another segment, the segment detection unit

detects the first segment as a segment in which the own device exists without detecting another segment in which the own device exists when a position of the own device is in a range of a predetermined distance from an end of the first segment, detects the other segment in which the own device exists when there is the position of the own device in a position that has been beyond the predetermined distance from the end of the first segment, calculates a time at which the own device begins to be in the other segment based on a time at which the other segment has been detected, the predetermined distance, and the speed of the vehicle detected by the acceleration sensor when the vehicle passes a point of the predetermined distance.

[Claim 6]

A detection device comprising:

a position detection unit that detects a position of

the own device and acquires a time at which the position is detected;

a segment detection unit that detects a segment correlating with the position detected by the position detection unit from a plurality of segments that are sections into which a road is divided;

a segment change determination unit that determines whether the segment in which the own device exists has changed based on the segments sequentially detected by the segment detection unit; and

a transmission unit that transmits information indicating the segment in which the own device exists, and information indicating a time at which the own device begins to be in the segment when the segment change determination unit has determined that the segment in which the own device exists has changed.

[Claim 7]

A server device comprising:

a position detection unit that detects a position of the own device and acquires a time at which the position is detected; a segment detection unit that detects a segment correlating with the position detected by the position detection unit from a plurality of segments that are sections into which a road is divided; a segment change determination unit that determines whether the segment in which the own device exists has changed based

on the segments sequentially detected by the segment detection unit; and a transmission unit that transmits information indicating the segment in which the own device exists, and information indicating a time at which the own device begins to be in the segment when the segment change determination unit has determined that the segment in which the own device exists has changed, and the server device includes a reception unit that receives the information indicating the segment and the information indicating the time from a detection device mounted on the vehicle.

[Claim 8]

A traffic information processing method performed by a detection device mounted on a vehicle, and a server device,

wherein the detection device

detects a position of the own device and acquires a time at which the position is detected,

sequentially detects a segment correlating with the detected position from a plurality of segments that are sections into which a road is divided, and determines whether the segment in which the own device exists has changed based on the sequentially detected segments, and

transmits information indicating the segment in which the own device exists, and information indicating a time at which the own device begins to be in the segment

when it is determined that the segment in which the own device exists has changed, and

the server device

receives the information indicating the segment and the information indicating the time from the detection device.

[Claim 9]

A computer for causing a computer to function as:

position detection means for detecting a position of the own device and acquiring a time at which the position is detected;

segment detection means for detecting a segment correlating with the position detected by the position detection means from a plurality of segments that are sections into which a road is divided;

segment change determination means for determining whether the segment in which the own device exists has changed based on the segments sequentially detected by the segment detection means; and

transmission means for transmitting information indicating the segment in which the own device exists, and information indicating a time at which the own device begins to be in the segment when the segment change determination means has determined that the segment in which the own device exists has changed.

[Claim 10]

A program for causing a computer communicating with a detection device mounted on a vehicle to execute a process of receiving information indicating a segment and information indicating a time from the detection device, the detection device including a position detection unit that detects a position of the own device and acquires a time at which the position is detected, a segment detection unit that detects a segment correlating with the position detected by the position detection unit from a plurality of segments that are sections into which a road is divided, a segment change determination unit that determines whether the segment in which the own device exists has changed based on the segments sequentially detected by the segment detection unit, and a transmission unit that transmits information indicating the segment in which the own device exists, and information indicating a time at which the own device begins to be in the segment when the segment change determination unit has determined that the segment in which the own device exists has changed.