

DESCRIPTION

Title of Invention

TRAVELING DIRECTION SPECIFICATION SYSTEM, TRAVELING
DIRECTION SPECIFICATION METHOD, TRAVELING DIRECTION
SPECIFICATION DEVICE, PROGRAM, AND RECORDING MEDIUM

Technical Field

[0001]

The present invention relates to a traveling direction specification system, a traveling direction specification method, a traveling direction specification device, a program, and a recording medium. This application claims priority based on Japanese Patent Application No. 2012-278496, filed December 20, 2012, the content of which is incorporated herein by reference.

Background Art

[0002]

In a vehicle information and communication system, various kinds of information pertaining to road traffic, such as congestion, construction, accidents, traffic restriction, parking lots, travel time, and emergency messages, are collected and provided.

[0003]

These kinds of information are collected to a vehicle information communication system center, edited, and then delivered to a user using a system, such as a radio beacon, an optical beacon, or FM (Frequency Modulation) multiplex broadcasting. The radio beacon or optical beacon is provided on a road, and provides information related to to the road.

[0004]

Information of the vehicle information and communication system provided by this structure is updated to latest information at every predetermined time. That is, in the vehicle information and communication system, congestion information and the like are available to a driver, whereby a road for use can be selected by avoiding a congested road and changing a use section of an expressway, or the like, and an arrival time to a destination can be predicted.

[0005]

In many cases, information of the vehicle information and communication system has content useful only for a driver in a vehicle which is traveling along one lane of inbound and outbound lanes. For example, congestion information or the like of the inbound lane has content useful only for a driver in a vehicle which is traveling along an inbound lane and unnecessary for a

driver in a vehicle which is traveling along an outbound lane.

[0006]

Accordingly, it is desirable to distribute information having this content only to a vehicle which is traveling along a target lane. However, the electric beacon or optical beacon has difficulty in transmitting information only within a range of either lane.

[0007]

Accordingly, as a method of solving these problems, it is considered that, when a reception device provided in a vehicle receives information, the traveling direction of a vehicle is specified, and only information useful for the traveling direction is provided to a driver. As a technique related to this background, various techniques are known (for example, see PTL 1).

[0008]

For example, PTL 1 describes a motion state determination device which is mounted in a mobile object. Specifically, this device detects the position of the mobile object on the earth. This device also detects the direction of the mobile object. Then, this device determines the motion state of the mobile object based on these detection results. In this way, according to this device, a technical configuration for determining the

motion state using information of the mobile object itself, such as the operation state of an engine or the speed of a wheel, is not provided. Accordingly, the motion state of the mobile object can be determined with high accuracy.

Citation List

Patent Literature

[0009]

[PTL 1] Japanese Unexamined Patent Application

Publication No. 2004-301650

Summary of Invention

Technical Problem

[0010]

The device described in PTL 1 calculates the traveling direction of the vehicle from the difference between the position of the vehicle detected by a GPS receiver at this time and the position of the vehicle detected previously. However, positioning by the GPS has an error. For this reason, according to this method, the traveling direction of the vehicle may not be accurately calculated.

[0011]

For example, referring to Fig. 9, it is assumed that information transmitted from a beacon B is information useful only for a driver in a vehicle which is traveling along a lane in a direction D1 of a road R. In other

words, it is assumed that information transmitted from the beacon B is information unnecessary for a driver of a vehicle which is traveling along a lane in a direction D2 of the road R.

[0012]

When a vehicle Va which is traveling along a lane enters a wireless communication range A of the beacon B, it is assumed that a GPS receiver of the vehicle Va detects a positioning position C2 as the position of the vehicle Va.

It is assumed that the GPS receiver of the vehicle Va detects a positioning position C1 as the position of the vehicle Va before the positioning position C2 is detected. In this case, according to the method of PTL 1, even though the traveling direction of the vehicle Va is the direction D1, it is calculated that the traveling direction of the vehicle Va is the direction D2, and information transmitted from the beacon B is not provided to the driver.

[0013]

When a vehicle Vb which is traveling along the lane enters the wireless communication range A of the beacon B, it is assumed that the GPS receiver of the vehicle Vb detects a positioning position C3 as the position of the vehicle Vb. It is assumed that the GPS receiver of the

vehicle Vb detects a positioning position C4 as the position of the vehicle Vb before the positioning position C3 is detected. In this case, according to the method of PTL 1, even though the traveling direction of the vehicle Vb is the direction D2, it is calculated that the traveling direction of the vehicle Vb is the direction D1, and unnecessary information transmitted from the beacon B is provided to the driver.

[0014]

The device described in PTL 1 calculates the direction of the vehicle based on information from a geomagnetic sensor. However, the method using the geomagnetic sensor increases cost and is not realistic. Accordingly, when accurately specifying the traveling direction of the vehicle, reduction in cost is demanded.

Solution to Problem

[0015]

In order to solve the above-described problems, a first aspect of the invention provides a traveling direction specification system which specifies the traveling direction of a vehicle. The traveling direction specification system includes a traveling direction specification device which specifies the traveling direction of the vehicle. The traveling direction specification device includes a traveling direction

specification unit which specifies the traveling direction of the vehicle in a road network based on a positional relationship between a first link where the vehicle is present and a second link where the vehicle has been present before the vehicle enters the first link.

[0016]

The traveling direction specification device may further include a link specification unit which performs map matching of a positioning result of the position of the vehicle by a GPS to specify a link in the road network where the vehicle is present, and the traveling direction specification unit may specify the traveling direction of the vehicle based on the positional relationship between a first link specified by the link specification unit and a second link specified by the link specification unit before the vehicle enters the first link.

[0017]

The traveling direction specification device may further include a data reception unit which receives data including notification information, which is notified to a driver of the vehicle, and traveling direction information designating the traveling direction of the vehicle to which the notification information is to be notified, a traveling direction determination unit which determines whether or not the traveling direction designated by the

traveling direction information included in data received by the data reception unit matches the traveling direction specified by the traveling direction specification unit, and a notification information output unit which outputs the notification information included in data received by the data reception unit when the traveling direction determination unit determines that the two traveling directions match each other.

[0018]

A second aspect of the invention provides a traveling direction specification method which specifies the traveling direction of a vehicle. The traveling direction specification method includes a traveling direction specification step of specifying the traveling direction of the vehicle in a road network based on the positional relationship between a first link where the vehicle is present and a second link where the vehicle has been present before entering the first link.

[0019]

A third aspect of the invention provides a traveling direction specification device which specifies the traveling direction of a vehicle. The traveling direction specification device includes a traveling direction specification unit which specifies the traveling direction of the vehicle in a road network based on the positional

relationship between a first link where the vehicle is present and a second link where the vehicle has been present before entering the first link.

[0020]

A fourth aspect of the invention provides a program which causes a computer to function as a traveling direction specification device satisfying the traveling direction of a vehicle. The program causes the computer to function as a traveling direction specification unit which specifies the traveling direction of the vehicle in a road network based on the positional relationship between a first link where the vehicle is present and a second link where the vehicle has been present before entering the first link.

[0021]

A fifth aspect of the invention provides a recording medium having recorded therein a program which causes a computer to function as a traveling direction specification device specifying the traveling direction of a vehicle. The program causes the computer to function as a traveling direction specification unit which specifies the traveling direction of the vehicle in a road network based on the positional relationship between a first link where the vehicle is present and a second link where the vehicle has been present before entering the first link.

[0022]

The summary of the invention does not necessarily describe all necessary features of the invention. The invention may also be a sub-combination of feature groups described above.

Advantageous Effects of Invention

[0023]

As will be apparent from the above description, according to the invention, it is possible to accurately specify the traveling direction of the vehicle without increasing costs.

Brief Description of Drawings

[0024]

Fig. 1 is a diagram showing an example of a road network G according to an embodiment.

Fig. 2 is a diagram showing an example of a vehicle which uses a vehicle information and communication system.

Fig. 3 is a diagram showing an example of the block configuration of an in-vehicle device 110.

Fig. 4 is a diagram showing an example of the operation flow of the in-vehicle device 110.

Fig. 5 is a diagram showing an example of data transmitted from a link specification unit 112 to a traveling direction specification unit 113 in the form of a table.

Fig. 6 is a diagram showing an example of data transmitted from the link specification unit 112 to the traveling direction specification unit 113 in the form of a table.

Fig. 7 is a diagram showing an example of the operation flow of the in-vehicle device 110.

Fig. 8 is a diagram showing an example of the hardware configuration of a computer 800 which constitutes the in-vehicle device 110 according to this embodiment.

Fig. 9 is a diagram showing an example of a use environment of a system which transmits information to a vehicle traveling on a road.

Description of Embodiments

[0025]

Hereinafter, the invention will be described based on the embodiments, which are not intended to limit the scope of the invention. All of the features and the combinations thereof described in the embodiments are not necessarily essential to the invention.

[0026]

Fig. 1 shows an example of a road network G according to an embodiment. The road network G is made by a combination of a plurality of nodes N1, N2, N3, ... (hereinafter, collectively referred to as a node N) and a plurality of links L1, L2, L3, ... (hereinafter,

collectively referred to as a link L). The node N refers to an intersection, a nodal point of the road network G in expression, or the like. The link L refers to a road section between two nodes N. A solid-line arrow in the drawing indicates an inbound lane. A broken-line arrow in the drawing indicates an outbound lane.

[0027]

A beacon B is provided on the roadside of a link L2. The beacon B is a device which transmits data including notification information, which is notified to a driver of a vehicle, such as road traffic information or the like in a vehicle information and communication system. Specifically, notification information also includes information useful to the driver of the vehicle which is traveling along either an inbound lane or an outbound lane. In this case, the beacon B transmits data including notification information and traveling direction information designating the traveling direction of a vehicle to which the notification information is to be notified.

[0028]

In this embodiment, for the purpose of preventing the description from becoming complicated, an example where one beacon B is provided in the road network G will

be described. However, a plurality of beacons B may be provided in the road network G.

[0029]

Fig. 2 shows an example of a vehicle which uses the vehicle information and communication system. The vehicle which uses the vehicle information and communication system includes an in-vehicle device 110, a GPS receiver 130, and a display 150. The in-vehicle device 110 may be an example of a "traveling direction specification device" in the invention.

[0030]

The GPS receiver 130 is a device which positions the position of the vehicle using radio navigation and autonomous navigation. Specifically, the GPS receiver 130 includes a GPS antenna, an acceleration meter, and an angular velocity meter. The GPS antenna is an antenna which receives radio waves from GPS satellites. The acceleration meter is a measuring instrument which measures change in acceleration when the vehicle moves. The angular velocity meter is a measuring instrument which measures change in angular velocity when the vehicle moves. The GPS receiver 130 is provided at a position where the GPS antenna is not shielded, for example, on a dashboard D of the vehicle, or the like. The GPS receiver 130 is electrically connected to the in-vehicle device 110. The

GPS receiver 130 positions the position of the vehicle using radio navigation by a GPS and autonomous navigation using the acceleration meter and the angular velocity meter. The GPS receiver 130 outputs data representing the positioning result to the in-vehicle device 110.

[0031]

The in-vehicle device 110 is a device which performs data processing according to the traveling direction of the vehicle. Specifically, the in-vehicle device 110 includes an antenna and a light receiver. The antenna is used to receive data transmitted from a radio beacon. The light receiver is used to receive data transmitted from an optical beacon. The in-vehicle device 110 is provided at a position where the antenna and the light receiver are not shielded, for example, on the dashboard D of the vehicle, or the like. The in-vehicle device 110 is electrically connected to the GPS receiver 130 and the display 150. If the input of data output from the GPS receiver 130 is received, the in-vehicle device 110 performs map matching of the positioning result represented by data to specify a link L in a road network G where the vehicle is present. If data transmitted from the beacon B is received through the antenna or the light receiver, the in-vehicle device 110 specifies the traveling direction of the vehicle in the road network G

based on the positional relationship between a first link L where the vehicle is present and a second link L where the vehicle has been present before entering the first link L. The in-vehicle device 110 determines whether or not the traveling direction designated by the traveling direction information included in data transmitted from the beacon B matches the specified traveling direction of the vehicle. When the two traveling directions match each other, the in-vehicle device 110 outputs data representing the notification information included in data transmitted from the beacon B to the display 150.

[0032]

The display 150 is a device which displays characters or figures. Specifically, the display 150 is provided at a position where a driver can visually recognize characters or figures, for example, in a center console C of the vehicle, or the like. The display 150 is electrically connected to the in-vehicle device 110. If the input of data output from the in-vehicle device 110 is received, the display 150 displays the notification information represented by data.

[0033]

In this embodiment, for the purpose of preventing the description from becoming complicated, a configuration in which the vehicle includes one in-vehicle device 110,

one GPS receiver 130, and one display 150 will be described. However, the vehicle may include a plurality of in-vehicle devices 110, GPS receivers 130, and displays 150.

[0034]

Fig. 3 shows an example of the block configuration of the in-vehicle device 110. The in-vehicle device 110 has a positioning data input reception unit 111, a link specification unit 112, a data reception unit 114, a traveling direction specification unit 113, a traveling direction determination unit 115, and a notification information output unit 116. In the following description, the function and operation of each component will be described in detail.

[0035]

The positioning data input reception unit 111 receives the input of data output from the GPS receiver 130.

[0036]

The link specification unit 112 performs map matching of the positioning result of the position of the vehicle by a GPS to specify a link in the road network G where the vehicle is present. Here, map matching is processing for, even if the positioning result shows a position other than a road, compulsively matching the

position of the vehicle on the road (comparing the positioned traveling route with map data, and even when the position is deviated from the road, correcting the position of the vehicle onto a nearby road) on the assumption that the vehicle travels on a road.

[0037]

The data reception unit 114 receives data including notification information, which is notified to the driver of the vehicle, and the traveling direction information designating the traveling direction of the vehicle to which the notification information is to be notified.

[0038]

The traveling direction specification unit 113 specifies the traveling direction of the vehicle in the road network G based on the positional relationship between the first link L where the vehicle is present and the second link L where the vehicle has been present before entering the first link L. Specifically, the traveling direction specification unit 113 specifies the traveling direction of the vehicle based on the positional relationship between the first link L specified by the link specification unit 112 and the second link L specified by the link specification unit 112 before the vehicle enters the first link L.

[0039]

The traveling direction determination unit 115 determines whether or not the traveling direction designated by the traveling direction information included in data received by the data reception unit 114 matches the traveling direction specified by the traveling direction specification unit 113.

[0040]

When the traveling direction determination unit 115 determines that the two traveling directions match each other, the notification information output unit 116 outputs the notification information included in data received by the data reception unit 114.

[0041]

Fig. 4 shows an example of the operation flow of the in-vehicle device 110. In this operation flow, processing for specifying the traveling direction of the vehicle will be described in detail. In the description of this operation flow, Figs. 1 to 3 are referred to.

[0042]

If the motor of the vehicle starts, the GPS receiver 130 starts to position the position of the vehicle. For example, the GPS receiver 130 repeatedly positions the position of the vehicle using radio navigation by the GPS and autonomous navigation using the acceleration meter and the angular velocity meter. Each time the position of the

vehicle is positioned, the GPS receiver 130 outputs data representing the positioning result to the in-vehicle device 110.

[0043]

If the input of data output from the GPS receiver 130 is received (S101), the positioning data input reception unit 111 of the in-vehicle device 110 transmits data to the link specification unit 112.

[0044]

Each time the input of data transmitted from the positioning data input reception unit 111 is received, the link specification unit 112 of the in-vehicle device 110 performs map matching of the positioning result of the position of the vehicle by the GPS represented by data on a digital map to specify a link L in the road network G where the vehicle is present (S102). Here, a plurality of links L shown on the digital map are associated with identification information for identifying each link L. The link specification unit 112 specifies a link corresponding to a position obtained by map matching as a link L in the road network G where the vehicle is present. When the vehicle is traveling, the link specification unit 112 specifies a new link L, in which the vehicle is traveling, over time. Each time a new link is specified, the link specification unit 112 transmits, to the

traveling direction specification unit 113, data shown in Figs. 5 and 6 including identification of a specified link L, identification information of links L connected to the entrance sides of an inbound lane and an outbound lane of the specified link L, and identification information of links L connected to the exit sides of the inbound lane and the outbound lane of the specified link L. For example, in the case of the road network G shown in Fig. 1, links L connected to the entrance side of an inbound lane of a link L6 are a link L4 and a link L7. Links L connected to the exit side of the inbound lane of the link L6 are a link L1, a link L2, and a link L5.

Links L connected to the entrance side of an outbound lane of the link L6 are a link L1, a link L2, and a link L5. Links L connected to the exit side of the outbound lane of the link L6 are a link L4 and a link L7.

[0045]

Each time data transmitted from the link specification unit 112 is received, the traveling direction specification unit 113 of the in-vehicle device 110 specifies the traveling direction of the vehicle (S103). Here, in each link of map data, the direction (link direction: positive direction) as the link is determined. That is, each end point of the link is determined as either a start point or an end point. The

traveling direction of the vehicle is expressed by positive/negative with respect to the link direction of the link (first link) where the vehicle is present. The traveling direction specification unit 113 determines to which of the start point and the end point of the first link the second link (the link where the vehicle has been present before entering the first link) is connected, and specifies the traveling direction of the vehicle from the direction in which the vehicle enters the first link. For example, if the second link is connected to the start point of the first link, it is determined that the traveling direction of the vehicle is "positive". For example, the traveling direction specification unit 113 specifies a lane of a link L in the traveling direction of the vehicle. Here, it is assumed that the traveling direction specification unit 113 receives data shown in Fig. 5 specifying the position of the vehicle as the link L6 and then receives data shown in Fig. 6 specifying the position of the vehicle as a link L2. In this case, the vehicle is moving from the link L6 to the link L2. In other words, the vehicle is moving along a lane in which the link L6 is connected to the entrance side of the link L2. Accordingly, the traveling direction specification unit 113 specifies the lane of the link L2 in the traveling direction, in which the link L on the entrance

side is the link L6, referring to data shown in Fig. 6. In this case, the traveling direction specification unit 113 specifies that the traveling direction of the vehicle is the inbound lane of the link L2.

[0046]

The in-vehicle device 110 repeats the processing of Steps S101 to S103 described above. In this way, the in-vehicle device 110 can accurately specify the traveling direction of the vehicle.

[0047]

Fig. 7 shows an example of the operation flow of the in-vehicle device 110. In this operation flow, processing when data is received from the beacon B will be described in detail. In the description of this operation flow, Figs. 1 to 6 are referred to.

[0048]

If the vehicle enters a wireless communication range A of the beacon B, the data reception unit 114 of the in-vehicle device 110 receives data transmitted from the beacon B (S201: Yes). The data reception unit 114 transmits data notifying of the reception of data to the traveling direction specification unit 113, transmits data representing the traveling direction information included in received data to the traveling direction determination unit 115, and transmits data representing the notification

information included in received data to the notification information output unit 116.

[0049]

If data transmitted from the data reception unit 114 is received, the traveling direction specification unit 113 of the in-vehicle device 110 transmits data representing the latest traveling direction of the vehicle specified until then to the traveling direction determination unit 115.

[0050]

If data transmitted from the data reception unit 114 and the traveling direction specification unit 113 is received, the traveling direction determination unit 115 of the in-vehicle device 110 determines whether or not the traveling direction represented by data received from the data reception unit 114 matches the traveling direction represented by data received from the traveling direction specification unit 113 (S203). The traveling direction specification unit 113 transmits data representing the determination result to the notification information output unit 116.

[0051]

The notification information output unit 116 of the in-vehicle device 110 receives data transmitted from the data reception unit 114. The notification information

output unit 116 receives data transmitted from the traveling direction determination unit 115. When the determination result represented by data is a determination result that the two traveling directions match each other (S203: Yes), the notification information output unit 116 outputs and displays the notification information represented by data received from the data reception unit 114 on the display 150 (S204). When the determination result represented by data received from the traveling direction determination unit 115 is a determination result that the two traveling directions do not match each other (S203: No), the notification information output unit 116 discards data received from the data reception unit 114 and does not display any information on the display 150.

[0052]

In this way, the driver of the vehicle can acquire only useful information according to the traveling direction of the vehicle.

[0053]

As described above, the in-vehicle device 110 specifies the traveling direction of the vehicle in the road network G based on the positional relationship between the first link L where the vehicle is present and

the second link L where the vehicle has been present before entering the first link L.

[0054]

In this way, according to the in-vehicle device 110, it is possible to accurately specify the traveling direction of the vehicle without increasing costs.

[0055]

As described above, the in-vehicle device 110 performs map matching of the positioning result of the position of the vehicle by the GPS to specify the link L in the road network G where the vehicle is present. The in-vehicle device 110 specifies the traveling direction of the vehicle based on the positional relationship between the specified first link and the specified second link before the vehicle enters the first link.

[0056]

In this way, according to the in-vehicle device 110, even if the GPS is used, it is possible to accurately specify the traveling direction of the vehicle without being affected by errors of the GPS.

[0057]

As described above, the in-vehicle device 110 receives data including the notification information, which is notified to the driver of the vehicle, and the traveling direction information designating the traveling

direction of the vehicle to which the notification information is to be notified. The in-vehicle device 110 determines whether or not the traveling direction designated by the traveling direction information included in received data matches the specified traveling direction. When the two traveling directions match each other, the in-vehicle device 110 outputs the notification information included in received data.

[0058]

In this way, the driver of the vehicle can acquire only useful information according to the traveling direction of the vehicle.

[0059]

In the above-described embodiment, the in-vehicle device 110 has been described as an example of a "traveling direction specification device" in the invention. However, the traveling direction specification device" in the invention is not limited to the in-vehicle device 110. For example, the "traveling direction specification device" in the invention may be a DSRC (Dedicated Short Range Communication) roadside wireless device.

[0060]

Fig. 8 shows an example of the hardware configuration of a computer 800 which constitutes the in-

vehicle device 110 according to this embodiment. The computer 800 according to this embodiment includes a CPU peripheral unit which has a CPU (Central Processing Unit) 802, a RAM (Random Access Memory) 803, a graphic controller 804, and a display 805 connected together through a host controller 801, an input/output unit which has a communication interface 807, a hard disk drive 808, and a CD-ROM (Compact Disk Read Only Memory) drive 809 connected together through an input/output controller 806, and a legacy input/output unit which has a ROM (Read Only Memory) 810, a flexible disk drive 811, and an input/output chip 812 connected to the input/output controller 806.

[0061]

The host controller 801 connects the RAM 803 to the CPU 802 and the graphic controller 804 which access the RAM 803 at a high transfer rate. The CPU 802 operates based on programs stored in the ROM 810 and the RAM 803 to control each unit. The graphic controller 804 acquires image data generated by the CPU 802 or the like in a frame buffer provided in the RAM 803 and displays image data on the display 805. Alternatively, the graphic controller 804 may internally include a frame buffer which stores image data generated by the CPU 802 or the like.

[0062]

The input/output controller 806 connects the host controller 801 to the communication interface 807, the hard disk drive 808, and the CD-ROM drive 809 which are comparatively high-speed input/output devices. The hard disk drive 808 stores programs and data used by the CPU 802 in the computer 800. The CD-ROM drive 809 reads programs or data from the CD-ROM 892 and provides the programs or data to the hard disk drive 808 through the RAM 803.

[0063]

The input/output controller 806 is also connected to the ROM 810, the flexible disk drive 811, and the input/output chip 812 which are comparatively low-speed input/output devices. The ROM 810 stores a boot program which is executed when the computer 800 is activated and/or programs and the like depending on hardware of the computer 800. The flexible disk drive 811 reads programs or data from the flexible disk 893 and provides the programs or data to the hard disk drive 808 through the RAM 803. The input/output chip 812 connects the flexible disk drive 811 to the input/output controller 806 and connects various input/output devices to the input/output controller 806 through, for example, a parallel port, a serial port, a keyboard port, a mouse port, and the like.

[0064]

The programs provided to the hard disk drive 808 through the RAM 803 are stored on a recording medium, such as the flexible disk 893, the CD-ROM 892, or an IC (Integrated Circuit) card, and are provided to a user. The programs are read from the recording medium, installed on the hard disk drive 808 in the computer 800 through the RAM 803, and executed in the CPU 802.

[0065]

A program which is installed on the computer 800 and causes the computer 800 to function as the in-vehicle device 110 causes the computer 800 to function as the traveling direction specification unit 113 which, in Step S103, specifies the traveling direction of the vehicle in the road network G based on the positional relationship between the first link L where the vehicle is present and the second link L where the vehicle has been present before entering the first link L.

[0066]

The program may cause the computer 800 to function as the link specification unit 112 which, in Step S102, performs map matching of the positioning result of the position of the vehicle by the GPS to specify the link L in the road network G where the vehicle is present, and the traveling direction specification unit 113 which, in Step S103, specifies the traveling direction of the

vehicle based on the positional relationship between the first link L specified by the link specification unit 112 and the second link L specified by the link specification unit 112 before the vehicle enters the first link L.

[0067]

The program may cause the computer 800 to function as the data reception unit 114 which, in Step S201, receives data including the notification information, which is notified to the driver of the vehicle, and the traveling direction information designating the traveling direction of the vehicle to which the notification information is to be notified, the traveling direction determination unit 115 which, in Step S203, determines whether or not the traveling direction designated by the traveling direction information included in data received by the data reception unit 114 matches the traveling direction specified by the traveling direction specification unit 113, and the notification information output unit 116 which, in Step S204, outputs the notification information included in data received by the data reception unit 114 when the traveling direction determination unit 115 determines that the two traveling directions match each other.

[0068]

Information processing described in the program is loaded to the computer 800, thereby functioning as the positioning data input reception unit 111, the link specification unit 112, the data reception unit 114, the traveling direction specification unit 113, the traveling direction determination unit 115, and the notification information output unit 116 which are specific means resulting from cooperation of software and various hardware resources described above. These specific means implement calculation or processing of information according to the usage of the computer 800 in this embodiment, whereby the characteristic in-vehicle device 110 according to the usage is constructed.

[0069]

For example, when the computer 800 performs communication with an external device or the like, the CPU 802 executes a communication program loaded to the RAM 803 and instructs the communication interface 807 to perform communication processing based on processing content described in the communication program. Under the control of the CPU 802, the communication interface 807 reads transmission data stored in a transmission buffer region or the like provided on a storage device, such as the RAM 803, the hard disk drive 808, the flexible disk 893, or the CD-ROM 892, to transmit read data to the network, or

the communication interface 807 writes reception data received from the network to a reception buffer region or the like provided on the storage device. In this way, the communication interface 807 may transfer transmission/reception data from and to the storage device using a direct memory access method. Alternatively, the CPU 802 may read data from a storage device or the communication interface 807 as a transfer source, and write data to the communication interface 807 or a storage device as a transfer destination, whereby transmission/reception data may be transferred.

[0070]

The CPU 802 loads all or a necessary part of a file or a database stored in an external storage device, such as the hard disk drive 808, the CD-ROM 892, or the flexible disk 893, to the RAM 803 using the direct memory access transfer or the like. Then, the CPU 802 performs various kinds of processing on data in the RAM 803. The CPU 802 writes processed data back to the external storage device using the direct memory access transfer or the like.

[0071]

In such processing, the RAM 803 is considered to temporarily store the content of the external storage device. Accordingly, the RAM 803, the external storage device, and the like are collectively referred to as a

memory, a storage unit, or a storage device in this embodiment. Various kinds of information, such as various programs, data, tables, and databases in this embodiment, are stored in such a storage device and serve as information processing targets. In addition, the CPU 802 can also hold a part of the RAM 803 in a cache memory and perform read and write operations on the cache memory. Even in such an embodiment, the cache memory undertakes some of the functions of the RAM 803. Accordingly, in this embodiment, it is assumed that the cache memory is included in the RAM 803, a memory, and/or a storage device, unless otherwise noted.

[0072]

The CPU 802 performs various kinds of processing specified by an instruction sequence in a program on data read from the RAM 803. Various kinds of processing include various kinds of calculation, processing of information, condition determination, and retrieval and replacement of information described in the embodiment. The CPU 802 writes processed data back to the RAM 803. For example, when the CPU 802 performs condition determination, the CPU 802 compares each of various variables shown in this embodiment with another variable or a constant and determines whether or not a condition is satisfied. The condition includes, for example, whether

or not the variable is greater than other variables or the constant, whether or not the variable is less than other variables or the constant, whether or not the variable is equal to or greater than other variables or the constant, whether or not the variable is equal to or less than other variables or the constant, and whether or not the variable is equal to other variables or the constant. When the condition is satisfied or is not satisfied, the process branches to a different instruction sequence, or a subroutine is called.

[0073]

In addition, the CPU 802 can search for information stored in files or databases stored in storage devices. For example, when a plurality of entries, in each of which an attribute value of a second attribute is associated with an attribute value of a first attribute, are stored in a storage device, the CPU 802 searches for an entry whose attribute value of the first attribute satisfies a specified condition from the plurality of entries stored in the storage device and reads the attribute value of the second attribute stored in the entry, thereby obtaining the attribute value of the second attribute associated with the first attribute satisfying the predetermined condition.

[0074]

The above-described programs or modules may be stored on an external storage medium. In addition to the flexible disk 893 and the CD-ROM 892, for example, an optical recording medium, such as a DVD (Digital Versatile Disk) or a CD (Compact Disk), a magneto-optical recording medium, such as an MO (Magneto-Optical Disk), a tape medium, or a semiconductor memory, such as an IC card, can be used as the storage medium. Moreover, a storage medium, such as a hard disk or a RAM provided in a server system connected to a dedicated communication network or the Internet, may be used as the recording medium, and the programs may be provided to the computer 800 through the network.

[0075]

While the invention has been described using the embodiment, the technical scope of the invention is not limited to the scope of the description of the above-described embodiment. It is obvious to those skilled in the art that various changes or improvements can be made in the above-described embodiment. It is obvious from the description of the claims that such changes or improvements are also included in the technical scope of the invention.

[0076]

It should be noted that, regarding the execution order of processes, such as operations, procedures, steps, and stages, in the systems, the methods, the devices, the programs, and the recording mediums described in the claims, the specification, and the drawings, expressions, such as "before" and "prior to", are not explicitly given, and the systems, the methods, the devices, the programs, and the recording mediums can be implemented in any order unless the output of a preceding process is used by a following process. Even when operation flows in the claims, the specification, and the drawings are described using expression, such as "first" and "next" for convenience, this does not mean that such order is required.

Industrial Applicability

[0077]

The invention can be applied to a traveling direction specification system, a traveling direction specification method, and a traveling direction specification device which specify the traveling direction of a vehicle, a program which causes a computer to function as the traveling direction specification device, and a recording medium having the program recorded therein.

Reference Signs List

[0078]

110: IN-VEHICLE DEVICE
111: POSITIONING DATA INPUT RECEPTION UNIT
112: LINK SPECIFICATION UNIT
113: TRAVELING DIRECTION SPECIFICATION UNIT
114: DATA RECEPTION UNIT
115: TRAVELING DIRECTION DETERMINATION UNIT
116: NOTIFICATION INFORMATION OUTPUT UNIT
130: GPS RECEIVER
150: DISPLAY
800: COMPUTER
801: HOST CONTROLLER
802: CPU
803: RAM
804: GRAPHIC CONTROLLER
805: DISPLAY
806: INPUT/OUTPUT CONTROLLER
807: COMMUNICATION INTERFACE
808: HARD DISK DRIVE
809: CD-ROM DRIVE
810: ROM
811: FLEXIBLE DISK DRIVE
812: INPUT/OUTPUT CHIP
892: CD-ROM
893: FLEXIBLE DISK
A: WIRELESS COMMUNICATION RANGE

B: BEACON
C: CENTER CONSOLE
D: DASHBOARD
G: ROAD NETWORK
L: LINK
N: NODE

Claims

[Claim 1]

A traveling direction specification system which specifies the traveling direction of a vehicle, the traveling direction specification system comprising:

a traveling direction specification device which specifies the traveling direction of the vehicle,

wherein the traveling direction specification device includes

a traveling direction specification unit which specifies the traveling direction of the vehicle in a road network based on a positional relationship between a first link where the vehicle is present and a second link where the vehicle has been present before entering the first link.

[Claim 2]

The traveling direction specification system according to claim 1,

wherein the traveling direction specification device further includes

a link specification unit which performs map matching of a positioning result of the position of the vehicle by a GPS to specify a link in the road network where the vehicle is present, and

the traveling direction specification unit specifies the traveling direction of the vehicle based on the positional relationship between a first link specified by the link specification unit and a second link specified by the link specification unit before the vehicle enters the first link.

[Claim 3]

The traveling direction specification system according to claim 1 or 2,

wherein the traveling direction specification device further includes

a data reception unit which receives data including notification information, which is notified to a driver of the vehicle, and traveling direction information designating the traveling direction of the vehicle to which the notification information is to be notified,

a traveling direction determination unit which determines whether or not the traveling direction designated by the traveling direction information included in data received by the data reception unit matches the traveling direction specified by the traveling direction specification unit, and

a notification information output unit which outputs the notification information included in data received by the data reception unit when the traveling direction

determination unit determines that the two traveling directions match each other.

[Claim 4]

A traveling direction specification method which specifies the traveling direction of a vehicle, the traveling direction specification method comprising:

a traveling direction specification step of specifying the traveling direction of the vehicle in a road network based on the positional relationship between a first link where the vehicle is present and a second link where the vehicle has been present before entering the first link.

[Claim 5]

A traveling direction specification device which specifies the traveling direction of a vehicle, the traveling direction specification device comprising:

a traveling direction specification unit which specifies the traveling direction of the vehicle in a road network based on the positional relationship between a first link where the vehicle is present and a second link where the vehicle has been present before entering the first link.

[Claim 6]

A program which causes a computer to function as a traveling direction specification device specifying the traveling direction of a vehicle,

wherein the program causes the computer to function as

a traveling direction specification unit which specifies the traveling direction of the vehicle in a road network based on the positional relationship between a first link where the vehicle is present and a second link where the vehicle has been present before entering the first link.

[Claim 7]

A recording medium having recorded therein a program which causes a computer to function as a traveling direction specification device specifying the traveling direction of a vehicle,

wherein the program causes the computer to function as

a traveling direction specification unit which specifies the traveling direction of the vehicle in a road network based on the positional relationship between a first link where the vehicle is present and a second link where the vehicle has been present before entering the first link