

Specification

[Title of the Invention] Information processing apparatus, information processing method, program, and trained model

[Technical Field]

[0001]

This invention relates to information processing apparatus, information processing methods, programs, etc.

[Background Technology]

[0002]

As an apparatus (system) to measure a certain measurement target, for example, there are those that can measure travel information such as vehicle position and acceleration information (e.g., Patent Document 1).

[Prior art references]

[Patent documents]

[0003]

[Patent document 1] Japanese Patent Publication No. 2022-58421

[Summary of Invention]

[0004]

This is just an example, but when considering the development of a new service (business) using measurement data measured by a device that measures a given measurement target as described above, it is usual to acquire a huge number of measurement data using the device as measurement data and evaluate them. This is a time-consuming and costly process.

In addition, at present, the locations where devices to measure are installed are limited, and it is desirable to install more devices to measure. However, due to cost issues, it is necessary to install them in locations where they can efficiently measure data.

[0005]

According to the first aspect of the invention, an information processing apparatus comprises: a data generation section that generates estimated data for second measurement data measured by a second device based on first measurement data measured by a first device that measures information about a mobility, the second device being different from the first device and measuring information about the mobility, and a model generation section that generates a model for calculating quantities related to the mobility using the second device based on the estimated data, wherein the data generation section generates the estimated data so that the estimated data is mathematically subsumed by the first measurement data.

According to the second aspect of the invention, an information processing method includes: generating estimated data for second measurement data measured by a second device based on first measurement data measured by a first device that measures information about a mobility, the second device being different from the first

device and measuring information about the mobility, generating a model for calculating quantities related to the mobility using the second device based on the estimated data, wherein the generating the estimated data includes generating the estimated data of the second measurement data so that the estimated data is mathematically subsumed by the first measurement data.

According to a third aspect of the invention, a program for causing a computer to execute: generating estimated data for second measurement data measured by a second device based on first measurement data measured by a first device that measures information about a mobility, the second device being different from the first device and measuring information about the mobility, generating a model for calculating quantities related to the mobility using the second device based on the estimated data, wherein the generating the estimated data includes generating the estimated data so that the estimated data is mathematically subsumed by the first measurement data.

According to the fourth aspect of the invention, the information processing apparatus is equipped with a first measurement unit that is required to evaluate the operation based on the first measurement data measured by a first device that measures information about a mobility and a second measurement data measured by a second device that is different from the first device. The first determination unit is provided with a first determination unit to determine the measurement period of the first measurement data required to evaluate the operation based on the second measurement data measured by the second device, which is different from the first device and measures information on the mobility.

According to the fifth aspect of the invention, the information processing method includes determining, based on first measurement data measured by a first device measuring information about a mobility, a first measurement period necessary for evaluating operation based on second measurement data measured by a second device that is different from the first device and that measures information about the mobility. The information processing method includes determining a measurement period of the first measurement data necessary to evaluate the operation based on the second measurement data measured by a second device different from the first device that measures information about the mobility.

According to a sixth aspect of the invention, a program for causing a computer to execute is based on first measurement data measured by a first device that measures information about a mobility, based on second measurement data measured by a second device that is different from the first device and that measures information about the mobility To cause the computer to perform: determining the measurement period of the first measurement data necessary for evaluating the operation.

According to the seventh aspect of the invention, an information processing apparatus generates, for a predetermined period of time, pseudo second measurement data measured by a second device that is different from the first device and that measures information about a mobility, based on the first measurement data measured by the first

device that measures information about the mobility. The second measurement data is measured by a second device different from the first device, which is a device for measuring information on a mobility based on the first measurement data measured by the first device, and is generated for a predetermined period of time.

According to an eighth aspect of the invention, the information processing method includes: generating, for a predetermined period of time, pseudo second measurement data based on the first measurement data measured by a first device measuring information about the mobility, which is measured by a second device that is different from the first device and obtaining data loss ratio information in the generated pseudo second measurement data, and determining the validity of the pseudo second measurement data for the predetermined period based on the data loss ratio information.

According to a ninth aspect of the invention, a program for execution by a computer includes the steps of: generating, based on first measurement data measured by a first device measuring information about a mobility, pseudo second measurement data measured by a second device, which is different from the first device, measuring information about the mobility The program for the computer to execute: generating, for a predetermined period of time, data loss ratio information in the generated pseudo second measurement data; and determining, based on the data loss ratio information, the validity of the pseudo second measurement data for the predetermined period of time.

According to the tenth aspect of the present invention, the information processing apparatus is a roadside unit that collects information on traveling of a moving vehicle based on a method corresponding to ETC 2.0. The first installation candidate facility location information acquiring unit acquires the first installation candidate facility location information, which is the location information of at least one facility where the roadside unit can be newly installed, and the travel information acquiring unit acquires the travel information collected based on a method different from the method corresponding to ETC 2.0, which includes at least information about the location of a mobility, The first calculation unit calculates the first degree of collection information regarding the degree of collection when it is assumed that the travel information is collected by the roadside unit corresponding to the existing roadside unit location information and the first installation candidate facility location information based on the method corresponding to ETC 2.0.

According to the eleventh aspect of the present invention, the information processing method includes acquiring existing roadside unit location information, which is the location information of an already installed existing roadside unit, by a roadside unit that acquires travel data of a mobility based on a system compatible with ETC 2.0. It also includes acquiring first candidate facility location information, which is the location information of at least one facility where the roadside unit can be newly installed, and acquiring travel information, which includes at least the location information of the

mobility, that was measured based on a system different from the system compatible with ETC 2.0. Furthermore, it includes calculating first collection degree information, which relates to the degree of collection of the travel information when measured virtually based on the system compatible with ETC 2.0, based on the existing roadside unit location information and the first candidate facility location information.

According to the twelfth aspect of the present invention, a program for execution by a computer causes the computer to: acquire existing roadside unit location information, which is the location information of an already installed existing roadside unit, by a roadside unit that acquires travel data of a mobility based on a system compatible with ETC 2.0; acquire first candidate facility location information, which is the location information of at least one facility where the roadside unit can be newly installed; acquire travel information, which includes at least the location information of the mobility, that was measured based on a system different from the system compatible with ETC 2.0; and calculate first collection degree information, which relates to the degree of collection of the travel information when measured virtually based on the system compatible with ETC 2.0, based on the existing roadside unit location information and the first candidate facility location information.

The computer is to calculate, based on the existing roadside unit location information and the first candidate facility location information, the first degree of collection information regarding the degree of collection of the travel information when the measurement is performed based on the method corresponding to ETC2.0 in a hypothetical case.

According to the tenth aspect of the invention, the information processing apparatus is provided with a mobility location information acquiring unit that acquires mobility location information based on a method different from the method corresponding to ETC 2.0 from a first device installed on the mobility, a density The density information acquiring section acquires the density information based on the acquired density information, and the identifying section identifies, based on the acquired density information, a location for installing a new roadside unit that acquires travel information based on a method corresponding to ETC 2.0.

According to the eleventh aspect of the invention, the information processing apparatus is equipped with a roadside unit location information acquiring unit for acquiring existing roadside unit location information, which is location information of at least one existing roadside unit, an output unit for outputting said roadside unit location information, and an The location identifying unit identifies the location.

According to the twelfth aspect of the invention, the information processing apparatus is equipped with a location information acquiring unit for acquiring location information of existing roadside units, which is location information of at least one existing roadside unit that acquires travel information based on a method corresponding to ETC 2.0, and a location identifying unit for installing a new roadside unit based on said existing roadside

unit location information. The location information is obtained based on the existing roadside unit location information.

According to the thirteenth aspect of the invention, the information processing apparatus is equipped with a facility location information acquiring unit that acquires facility location information, which is location information of a facility where a new roadside unit that acquires travel information based on a method corresponding to ETC 2.0 can be installed, and an identifying unit that identifies, based on said facility location information, a location for installing said new roadside unit. The location information is obtained based on the location information of a facility where a new roadside unit can be installed based on the facility location information.

According to the fourteenth aspect of the invention, the information processing method includes: acquiring mobility location information based on a method different from the method corresponding to ETC 2.0 from a first device installed on the mobility; acquiring density information of the mobility location information based on the acquired mobility location information; and identifying, based on the density information, a location for installing a new roadside unit that acquires travel information based on a method corresponding to ETC 2.0.

According to a fifteenth aspect of the invention, the information processing method includes: obtaining existing roadside unit location information, which is location information of at least one existing roadside unit; outputting said roadside unit location information; and identifying a location for installing a new roadside unit based on user input made in response to said output. (2) the location of the new roadside unit.

According to the sixteenth aspect of the invention, the information processing method includes: obtaining location information of at least one existing roadside unit, which is location information of at least one existing roadside unit that obtains travel information based on a method corresponding to ETC 2.0; and identifying a location for installing a new roadside unit based on said location information of the existing roadside unit, The method includes the following

According to the seventeenth aspect of the invention, the information processing method includes: acquiring facility location information, which is location information of a facility where a new roadside unit that acquires travel information based on a method corresponding to ETC 2.0 can be installed; identifying, based on said facility location information, a location for installing said new roadside unit The method includes.

According to the eighteenth aspect of the invention, the program for execution by a computer includes: acquiring, from a first device installed on a mobility, mobility location information based on a method different from the method corresponding to ETC 2.0, density information of the mobility location information based on the acquired mobility location information The program for identifying a location for installing a new roadside unit that acquires travel information based on a method corresponding to ETC 2.0, based on the acquired density information.

According to a nineteenth aspect of the invention, the program for execution by a computer includes: obtaining location information of at least one existing roadside unit, which is location information of the existing roadside unit; outputting the roadside unit location information; and identifying a location for installing a new roadside unit based on user input made in response to the output. The program causes the computer to perform the tasks of: obtaining at least one existing roadside unit location

According to the twentieth aspect of the invention, the program for having a computer execute the following tasks: obtaining location information of at least one existing roadside unit that obtains travel information based on a method corresponding to ETC 2.0, and identifying a location for installing a new roadside unit based on said location information of the existing roadside unit. The computer is to identify a location for installing a new roadside unit based on the existing roadside unit location information.

According to the 21st aspect of the present invention, the program for having a computer execute the following tasks: acquiring location information of a facility, which is location information of a facility where a new roadside unit that acquires travel information based on a method corresponding to ETC 2.0 can be installed; and identifying, based on said facility location information, a location for installing said new roadside unit. The program causes the computer to identify a location for installing the new roadside unit based on the facility location information.

[Brief description of the drawing]

[0006]

[Fig. 1] Illustration of the principle behind the implementation.

[Fig. 2] Illustration of the principle behind the implementation.

[Fig. 3] Flowchart showing an example of the process flow for the implementation.

[Fig. 4] An example of the functional configuration of the server for the first embodiment.

[Fig. 5] Illustration of the principle behind the first embodiment.

[Fig. 6] Illustration of the principle behind the first embodiment.

[Fig. 7] Illustration of the principle behind the first embodiment.

[Fig. 8] Illustration of the principle behind the first embodiment.

[Fig. 9] Flowchart showing an example of the process flow for the first embodiment.

[Fig. 10] An example of information stored in the memory of the server for the second embodiment.

[Fig. 11] Flowchart showing an example of the process flow for the second embodiment.

[Fig. 12] An example of a histogram for the second embodiment.

[Fig. 13] An example of a histogram for the second embodiment.

[Fig. 14] An example of information stored in the memory of the server for the third embodiment.

[Fig. 15] Illustration of the principle for the third embodiment.

[Fig. 16] Illustration of the principle for the third embodiment.

[Fig. 17] Illustration of the principle for the third embodiment.

[Fig. 18] Flowchart showing an example of the process flow for the third embodiment.

[Fig. 19] An example of information stored in the memory of the server for the fourth embodiment.

[Fig. 20] Illustration of the principle for the fourth embodiment.

[Fig. 21] Flowchart showing an example of the process flow for the fourth embodiment.

[Fig. 22] Illustration of the principle for the fourth embodiment.

[Fig. 23] Illustration of the principle for the fourth embodiment.

[Fig. 24] Illustration of the principle for the fourth embodiment.

[Embodiments for carrying out the invention]

[0007]

The following is an example of an embodiment of the present invention with reference to the drawings.

In the description of the drawings, identical elements are marked with the same symbol and duplicate explanations may be omitted.

However, the components described in this embodiment are examples only and are not intended to limit the scope of the invention to them.

[0008]

<Formulation>

The following is an example of an embodiment of the invention.

[0009]

<Principle>

1.1 Principles of Data Estimation

Fig. 1 illustrates the flow of processing performed by an information processing apparatus.

The information processing apparatus has, for example, a second device measurement data estimation unit 11 that generates (estimates) data when the measurement target is measured by a second device different from a first device based on the data of the measurement target measured by the first device (hereinafter referred to as "first device measurement data"). The measurement may be a detection or a gauging. The same may be applied hereinafter. The data generated by the second device measurement data estimation unit 11 is referred to as "estimated second device measurement data".

[0010]

The first device may be, for example, a device that measures a measurement target at a predetermined time interval (hereinafter referred to as "predetermined time interval"). In this case, the first device measurement data is the data measured by the first device at each predetermined time interval.

[0011]

The second device can be, for example, a device in which a sampling unit (which may be called the unit of measurement) is different from that of the first device. For example, if the first device measures the measurement target at each predetermined time interval

with the sampling unit as time, as described above, the second device can be a device that measures the measurement target with a sampling unit other than time.

In performing the learning and other processes described below, it is of course preferable to use the measurement data from the second device as the training data, but it is a feature of this invention that data generated from the measurement data from the first device can be used. However, transfer learning is merely a method in which a model learned for a certain task is used as a starting point for a model that performs a similar task, and is fundamentally different from the present invention, which uses data generated from other data on a zero-based basis.

[0012]

For example, if the measurement target is the position of the device (position information), the first device can be a device that measures a position at predetermined time intervals.

In this case, the second device can be, for example, a device that measures a position with the sampling unit as "distance" and at predetermined distance interval (hereinafter referred to as "predetermined distance interval").

[0013]

In this example, if the predetermined time interval is set to "1 second interval" and the predetermined distance interval is set to "100 m," then the second device measurement data estimation unit 11 can, for example, generate estimated second device measurement data by thinning (resampling) the position measurement data for each second in the first device measurement data to every "100 m" based on their position information.

[0014]

When a set of multiple first device measurement data is defined as a "first device measurement data set," the second device measurement data estimation unit 11 can generate estimated second device measurement data corresponding to each first device measurement data by performing the above process for each first device measurement data in the first device measurement data set. The set of estimated second device measurement data generated in this manner may be referred to as the "estimated second device measurement data set".

[0015]

At least one of the first and second devices may be a device that measures the measurement target based on multiple sampling units (e.g., distance and acceleration: the distance is obtained when the value of acceleration is not less than (or exceeds) a threshold value, etc.).

It can be any other device than this.

[0016]

1.2. machine learning using estimated measurement data

Fig. 2 illustrates the principles of learning and inference using estimated measurement data in this form.

[0017]

(1) During Training

As shown in (1) of Fig. 2, the information processing apparatus has, for example, the aforementioned second device measurement data estimation unit 11, a first model processing unit 13, and a second model generation unit 15 as functional parts.

[0018]

The first model processing unit 13 can be, for example, a functional section that uses a predetermined model (an existing model) as the first model and calculates (computes) predetermined quantities using certain measurement data as input to the first model. The quantities may be regarded as objects to be calculated. The same can be applied hereafter.

In this embodiment, the first model processing unit 13 calculates predetermined quantities using the aforementioned first device measurement data as input to the first model.

[0019]

The second model generation unit 15 can be, for example, a functional part that generates a second model capable of calculating the same quantities as the first model above.

In this embodiment, the second model generation unit 15 generates a second model by machine learning using, for example, the estimated second device measurement data generated by the second device measurement data estimation unit 11 described above and quantities calculated by the first model processing unit 13 as the data set for learning. The second model generated in this way is referred to as the "Trained second model".

The second model is not limited to machine learning models. For example, the second model generation unit 15 may be a mathematical statistical model such as linear and nonlinear regression models, or a connectionist model such as a DNN (Deep Neural Network).

The quantities calculated by the first model processing unit 13 are referred to here as "Training quantities" (Training data) because they can be said to be desirable data (correct data, so to speak) that are calculated using the existing first model.

[0020]

(2) During inference

As shown in (2) of Fig. 2, the information processing apparatus has, for example, a trained second model processing unit 17 as a functional part.

[0021]

The trained second model processing unit 17 can, for example, be a functional unit that calculates predetermined quantities by using data of a measured object by the second device (hereinafter referred to as "second device measurement data") as input to the trained second model. The trained second model processing unit 17 can be a functional unit that calculates predetermined quantities by using the data measured by the second

device (hereinafter referred to as "second device measurement data") as input to the trained second model.

In other words, the trained second model processing unit 17 uses the data actually measured by the second device as input, infers predetermined quantities using the trained second model, and outputs the inference results (hereinafter referred to as "quantity inference results").

[0022]

In addition to the above, for example, the estimated second device measurement data may be used as input data to the first model, and some data (e.g., data of elements that can affect quantities, data of elements that are related to quantities) corresponding to the first device measurement data accumulated from the past may be used as the training data to generate the second model by machine learning, etc.

[0023]

<Processing>

Fig. 3 is a flowchart showing an example of the process flow shown in Fig. 2.

First, the information processing apparatus performs the training data set generation process.

In the training data set generation process, the information processing apparatus performs Loop A processing (A1-A7) on each of the first device measurement data to be processed (in the example in Fig. 2, each first device measurement data included in the first device measurement data set).

The first device measurement data to be processed may be, for example, data with the same measurement period.

[0024]

In the Loop A process, the second device measurement data estimation unit 11 generates estimated second device measurement data based on the first device measurement data (A3).

The first model processing unit 13 calculates training quantities based on said first device measurement data and the first model (A5).

The information processing apparatus then moves the process to the next first device measurement data.

[0025]

For example, if A3 and A5 have been processed for all first device measurement data to be processed, the information processing apparatus terminates processing of loop A (A7).

[0026]

The information processing apparatus then performs the training process (A9).

Specifically, the second model generator 15 generates a trained second model by supervised learning, for example, based on the estimated second device measurement data generated in the loop A process and the training quantities generated in the loop A process.

[0027]

Next, the information processing apparatus performs inference process (A11).

Specifically, the trained second model processing unit 17 calculates quantities based on the trained second model generated in A9 and the second device measurement data for each processing target (in the example in Fig. 2, each second device measurement data included in the second device measurement data set). The calculated results are used as the inference results of the quantities.

The information processing apparatus then terminates the process.

[0028]

The step A11 may be omitted and the process may be performed until the model is generated.

Alternatively, the process may be performed only in step A3, up to generating estimated second device measurement data based on the first device measurement data.

[0029]

The principle has been explained above, but the measurement target can be, for example, information about a mobility.

[0030]

The mobility may include, for example, at least one of the following

Four-wheeled vehicle

Motorcycles

Personal Mobility

Vessels

Railroad Train

A flying object (at least one of drone and aircraft)

[0031]

The information about the mobility may include, for example, at least one of the following

Position information of mobility

Speed information of mobility

Acceleration information of mobility

Direction information of mobility (orientation information)

Angular velocity information of mobility

Time information (e.g., clock information) of mobility

Information including at least one of these pieces of information may be used as the traveling information of the mobility.

[0032]

The measurement target is not limited to information about the mobility (e.g., traveling information), but may be other information as well.

For example, the same process as above may be performed with "sound" as the measurement target, "time" as the sampling unit for the first device, and "frequency" as the sampling unit for the second device.

The same process as above may also be performed, for example, using information about the living body (blood pressure, pulse rate, heart rate, respiratory rate, body temperature, brain waves, etc.) as the measurement target. In this case, the same processing as above may also be performed, for example, using "time" as the sampling unit for the first device and "frequency" as the sampling unit for the second device.

[0033]

<Embodiments>

Next, an embodiment of a server, which is an example of one of the above information processing apparatus, will be described.

The following describes an example in which a vehicle such as a four-wheeled vehicle is applied as a mobility.

The information processing apparatus is not limited to a server, but can also be, for example, an electronic device such as a personal computer, a cell phone including a smart phone, a PDA, and various tablet terminals (which may be called a terminal). The information processing apparatus may also be a computer device. These devices, including servers, may also be referred to as computer device.

However, examples to which the invention can be applied are not limited to the examples described below.

[0034]

<First Embodiment>

These days, ETC2.0 is becoming popular. For example, it is conceivable to develop telematics insurance products as a service (business) based on ETC2.0.

However, this requires measurement data obtained by having the driver actually drive a vehicle equipped with ETC2.0-compliant device (e.g., ETC2.0-compliant on-board device or DSRC (Dedicated Short Range Communications)-compliant on-board device) and the corresponding accident data. This requires time and money costs.

[0035]

In this case, for example, by estimating (reproducing) data measured by a device compatible with ETC 2.0 from data already measured (acquired data) by a device different from the device compatible with ETC 2.0, it is possible to develop insurance products, etc. by omitting data collection with the device compatible with ETC 2.0. This is considered to be possible.

[0036]

In the development of telematics insurance products, for example, a score related to the driver's driving (driving quality) (hereinafter referred to as "driving score" (driving quality score)) and a model of the driver's driving quality (hereinafter referred to as "driving score model" (driving quality score model)) are used.

Generally speaking, a driving score model can be constructed as a model in which at least one of the following factors (including factors standardized per unit of time or per unit of distance, etc.) affects the score value, for example The model can be constructed as a model in which at least one of the following factors (including factors standardized

per unit time, per unit distance, etc.) affect the score value.

Number of times of sudden steering (or frequency of sudden steering or distribution of steering wheel operation including sudden steering)

Number of sudden deceleration (or frequency of sudden deceleration or distribution of deceleration including sudden deceleration)

Number of sudden acceleration (or frequency of sudden acceleration or distribution of acceleration including sudden acceleration)

Number of overspeeds (or frequency of overspeeds or distribution of speeds including overspeeds)

[0037]

For example, a driving score model can be constructed such that the greater the frequency of these factors (or the higher the frequency or the degree of sudden maneuvering or excessive speed), the higher the accident risk becomes and the larger (or conversely, the smaller) the driving score becomes.

And, as one of the uses of this driving score (utilization method), for example, the driving score can be reflected in the insurance premium of telematics insurance (insurance premium can be decided based on the driving score).

[0038]

This embodiment describes a method of generating an estimated ETC2.0 measurement data that reflects at least the driver's general driving tendencies, although the above factors are not always strictly reflected, and then generating a driving score model based on this generated estimated ETC2.0 measurement data.

[0039]

The contents described in the first embodiment can be applied to any of the other embodiments or other variations.

[0040]

<Functional Configuration>

Fig. 4 shows an example of the functional configuration of a server 100 in this example. The server 100 can be, for example, a computer system with a processing unit (control unit) 110, an operation unit 120, a display unit 130, a sound output unit 140, a communication unit 150, a clock unit 160, and a storing unit 190, all connected via a bus B.

[0041]

The processing unit 110 is a processor or control unit that comprehensively controls each part of the server 100 or performs various processes in accordance with various programs, such as a system program stored in the storing unit 190, for example. It consists of a processor such as a CPU (Central Processing Unit), GPU (Graphics Processing Unit), DSP (Digital Signal Processor), etc., or an integrated circuit such as an ASIC (Application Specific Integrated Circuit), FPGA (Field Programmable Gate Array), etc. The system consists of integrated circuits such as ASIC (Application Specific Integrated Circuit), FPGA (Field Programmable Gate Array), etc.

[0042]

The operation unit 120 comprises input devices, such as operation buttons and operation switches, for the user to perform various operational inputs to the server 100. The operation unit 120 may also have a touch panel integrally configured with the display unit 130, which may function as an input interface between the user and the server 100. From the operation unit 120, operation signals in accordance with user operations are output to the processing unit.

[0043]

The display unit 130 is a display device composed of an LCD or the like, and displays various indications based on display signals output from the processing unit 110. Display unit 130 may be integrally configured with a touch panel to form a touch screen.

[0044]

The sound output unit 140 is a sound output device composed of a speaker or the like, and outputs various sounds based on sound output signals output from the processing unit 110.

[0045]

The communication unit 150 is a communication device for sending and receiving information used inside the device to and from external devices. Various communication methods can be applied to the communication unit 150, including a wired connection via a cable conforming to a predetermined communication standard, a connection via an intermediate device called a cradle that doubles as a charger, and a wireless connection using radio communication.

[0046]

The clock unit 160 is a built-in clock of the server 100 and outputs time information (timekeeping information). The clock unit 160 is composed of, for example, a clock using a crystal oscillator.

The clock unit 160 may be configured with a clock that applies the NITZ (Network Identity and Time Zone) standard or other standards.

[0047]

The storing unit 190 is a storage device composed of a volatile or nonvolatile memory such as ROM, EEPROM, flash memory, RAM, etc., or a hard disk device.

[0048]

In this example, the storing unit 190 stores, for example, a driving score model processing program 191, a cigar socket-type device measurement database 192, an ETC2.0 measurement database 193, an estimated ETC2.0 measurement database 194, a first driving score model data 195, a trained second driving score model data 196 are stored.

[0049]

The driving score model processing program 191 is a program that is read by the processing unit 110 and executed as the driving score model processing described below.

[0050]

The cigar socket-type device measurement database 192 is, for example, a database in which cigar socket-type device measurement data including travel information measured by cigar socket-type devices installed in vehicles is accumulated and stored.

Cigar socket-type devices are a type of the first device, and the cigar socket-type device measurement data can be a type of first measurement data (first device measurement data).

[0051]

The processing unit 110 may add at least one of the following information (attribute information) to the first device measurement data, in addition to information about the vehicle (mobility), for example.

Vehicle information (vehicle type, year, model number, etc.)

Driver information (gender, age, address, use, etc.)

[0052]

A cigar socket type device is a device that can be plugged into a vehicle's accessory socket and used to measure vehicle travel information (information about mobilities) based on various built-in sensors and inertial measurement units (IMU (Inertial Measurement Unit)), for example.

[0053]

The first device is not limited to a cigar socket type device. It may be any device that can acquire information about a mobility and that is directly or indirectly provided to the mobility. For example, the first device may be at least one of the following devices.

Drive Recorder

Digital tachograph

Any in-vehicle device installed in or built into the vehicle (may include connected cars).

An in-vehicle device with communication functionality (for example, Bluetooth® communication functionality) that collects data in conjunction with a smartphone or other terminal, and the terminal associated with it

Device stand-alone, including smartphones and other terminals

Devices that include these devices, such as vehicle-embedded and retrofitted in-vehicle device and terminals such as smartphones.

[0054]

Travel information can include, for example, position, speed, acceleration, angular velocity, and other information, and any sensor or other device capable of measuring such information can be installed in a cigar socket-type device. The device can be configured to measure at least one of these pieces of information.

[0055]

The travel information measured by the cigar socket-type device can, for example, be sent to the server 100 or cloud server at any time or at regular intervals.

[0056]

It is also possible to provide a satellite positioning unit (satellite positioning sensor), which is a unit (sensor) that detects position and speed using a satellite positioning

system such as GPS (Global Positioning System), or a UWB positioning unit (UWB positioning sensor), which is a unit (sensor) used to calculate position using UWB (Ultra Wide Band), in a cigar socket-type device.

[0057]

The satellite positioning unit may include, for example, an RF (Radio Frequency) receiving circuit that converts RF signals, including satellite positioning signals transmitted from positioning satellites and received by an unillustrated antenna, into digital signals, and a baseband processing circuit that performs correlation processing on the digital signals output by the RF receiving circuit to capture the satellite positioning signals, and outputs information such as satellite orbit data and time data extracted from the satellite positioning signals as positioning information. Additionally, the unit may be configured to detect not only position but also information such as speed through Doppler positioning or similar methods.

[0058]

The inertial measurement unit (IMU) can, for example, be configured to have inertial sensors that detect information necessary to calculate travel information by inertial navigation operations. The inertial sensors can include, for example, a 3-axis accelerometer and a 3-axis gyro sensor, and can output the acceleration detected by the accelerometer and the angular velocity detected by the gyro sensor.

[0059]

The UWB positioning unit may, for example, have an ultra-wideband RF receiver circuit that converts ultra-wideband RF signals, including ultra-wideband pulse signals for positioning, transmitted from a beacon for positioning that is received by an antenna not shown in the figure, into digital signals, and an ultra-wideband RF receiver circuit that calculates the relative position between the device and the beacon for positioning based on the digital signals output from the ultra-wideband RF receiver circuit. The system can have a relative position calculation processing circuit that calculates the relative position between the device and the positioning beacon based on the digital signal output from the ultra-wideband RF receiver circuit.

The UWB positioning unit may or may not function as a beacon for positioning by allowing its own device to transmit ultra-wideband RF signals, including ultra-wideband pulse signals for positioning, from an unshown antenna.

[0060]

The cigar socket-type device measurement database 192 can store the measurement data of multiple drivers for each measurement period, for example. In other words, the measurement data of multiple drivers can be stored in association with a measurement period.

The measurement period may be, for example, a monthly period (1 month, 2 months, ..., 6 months, etc.) or any other unit of time. For example, measurement data may be stored by road type or by region.

[0061]

The ETC2.0 measurement database 193, for example, is a database in which ETC2.0 measurement data including travel information measured by ETC2.0 on-board device (ETC2.0 compatible on-board device, DSRC compatible on-board device) installed in vehicles and ETC2.0 compatible car navigation devices that can be linked to the ETC2.0 device are stored and saved. This is a database.

The ETC2.0 on-board unit is a type of the first device, and the ETC2.0 measurement data can be a type of the second measurement data (second device measurement data).
[0062]

ETC2.0 measurement data can be obtained by the server 100 based on the probe information recorded in the ETC2.0 on-board unit and collected by devices such as ITS spots and route information collectors installed (deployed) on the road (hereinafter comprehensively referred to as "roadside unit").

[0063]

Roadside units are installed at, for example, several thousand locations on highways and direct-controlled national highways throughout Japan.

The roadside unit and the ETC2.0 on-board unit can be configured to enable bidirectional communication, for example, so that the roadside unit collects probe information from the ETC on-board unit and the ETC2.0 on-board unit provides information to support safe driving, such as route guidance information according to road conditions, information on obstacles ahead, information on frequent accident locations, etc.

[0064]

ETC2.0 on-board device can also be equipped with various sensors and units, for example, as described above, to measure and record various types of travel information. Then, when a vehicle equipped with an ETC2.0 on-board unit passes in the vicinity of a roadside unit, the probe information can be transmitted to the server 100 or probe server via the roadside unit.

Various sensors and units may be installed in ETC2.0 compatible car navigation devices, etc., and various travel information may be recorded in ETC2.0 on-board device based on information output (transmitted) from ETC2.0 compatible car navigation devices.

[0065]

Here, the probe information can include, for example, the following information

Basic Information

Travel history information

Behavior history information

[0066]

Basic information can include, for example, information about ETC2.0 on-board device, information about ETC2.0 compatible car navigation devices, and information about the vehicle.

[0067]

The travel history information can include, for example, time, position, and speed information.

This travel history information can, for example, be recorded (accumulated) every time the vehicle is detected to have traveled "200 meters". In addition to this, for example, the information may be recorded when the vehicle's direction of travel changes by "45 degrees" or more.

The value "200 m" is based on the ETC2.0 specification, but it is not limited to this value. Similarly, "45 degrees" may be set to "22.5 degrees," for example. The distance such as "200 m" based on the ETC2.0 specification is referred to as the "unit distance" for convenience.

As described below, it is also possible to change the unit distance according to road type and speed zone.

[0068]

Behavior history information can include, for example, time information, position information, orientation information, acceleration information (forward/backward acceleration, left/right acceleration, etc.), angular rate information (yaw angular rate information, for example), and other information.

This behavior history information is, for example, a threshold value for front/rear acceleration, left/right acceleration, or yaw angular velocity (for example, the threshold value for front/rear acceleration "-0.25G", the threshold value for left/right acceleration " $\pm 0.25G$ ", the threshold value for yaw angular velocity " ± 8.5 deg/sec", etc.. (These threshold values are examples.) The peak value can be made to be recorded (accumulated) when the value exceeds. For example, front/rear acceleration of "0.25G" or more indicates abrupt behavior and may indicate that actions such as crisis avoidance have been taken.

[0069]

The travel history and behavior history information may include road type information (e.g., expressway, urban expressway, general road, other, etc., information on speed zones, etc.).

[0070]

At least one of the above information, for example, at least one of the travel history information and the behavior history information, may be used as travel information.

[0071]

In ETC 2.0, for example, from the viewpoint of personal information protection, travel information (e.g., at least travel history information) at the starting point of travelling (e.g., within 500 m from the starting point of travelling) and the ending point of travelling (e.g., within 500 m from the ending point of travelling) can be prevented from being obtained.

Not obtained may mean that the information is not recorded in the ETC2.0 on-board unit or not transmitted to the roadside unit.

[0072]

The estimated ETC2.0 measurement database 194 is a database in which the estimated ETC2.0 measurement data generated based on the cigar socket type device

measurement data is stored accumulatively.

Estimated ETC 2.0 measurement data can be a type of estimated data (estimated second device measurement data).

[0073]

The first driving score model data 195 is the data for the first driving score model, which is the basis for the driving score used to determine insurance premiums and other costs for the vehicle.

[0074]

The trained second driving score model data 196 is the data of the driving score model generated by the training using estimated ETC 2.0 measurement data and other data.

[0075]

Here, the driving score model can be, for example, a mathematical model for calculating a driving score for telematics insurance.

Telematics insurance, for example, can be designed so that the insurance company obtains travel information measured by a device installed in the vehicle (e.g., automobile), driving speed, braking style, etc., and analyzes the driver's accident risk from this information to calculate insurance premiums.

[0076]

The driving score model can be, for example, a model in which the driver's accident risk (accident risk) can be estimated, and in which the driving score is calculated as a value in a numerical range, such as "0 to 1", "0 to 10", or "0 to 100". For example, the model can be such that the larger the driving score is, the higher the accident risk is estimated (the smaller the driving score is, the lower the accident risk is estimated). In this case, the insurance company can make the premium higher for a higher driving score and lower for a lower driving score.

Conversely, the model may be designed so that the higher the driving score is, the lower the estimated accident risk becomes.

[0077]

The input to the driving score model can be the measured data of travel information, and the driving score can be calculated based on the measured data of travel information.

In this example, for example, the existing first driving score model is used as a base, and a trained second driving score model is generated by the method described below.

The driver's actual ETC2.0 measurement data can then be input into the trained second driving score model to enable calculation of that driver's driving score.

[0078]

The cloud server may be used as the server 100.

If the server 100 is separate from the cloud server, the server 100 may be used to retrieve cigar-socket type device measurement data from the cloud server.

The server that performs the process described below should acquire or otherwise store the same data that is stored in the storing unit 190 of the server 100.

[0079]

Similarly, the probe server may be the server 100.

If the server 100 is separate from the probe server, the server 100 may acquire ETC 2.0 measurement data from the probe server.

The server that performs the process described below should acquire or otherwise store the same data that is stored in the storing unit 190 of the server 100.

[0080]

<Principles>

Fig. 5 illustrates the principles of training and inference using the estimated ETC2.0 measurement data in this example and corresponds to Fig. 2.

[0081]

(1) During training

As shown in (1) of Fig. 5, the processing unit 110 of the server 100 has, for example, an ETC2.0 measurement data estimation unit 111, a first driving score model processing unit 113, and a second driving score model generation unit 115 as functional parts. The ETC 2.0 measurement data estimation unit 111 can be a type of the second device measurement data estimation unit 11 in (1) of Fig. 2.

The first driving score model processing unit 113 can be a type of the first model processing unit 13 in (1) of Fig. 2.

The second driving score model generator 115 can be a type of the second model generator 15 in (1) of Fig. 2.

[0082]

Figures 6 through 7 show an example of a method for generating estimated ETC 2.0 measurement data.

In Fig. 6, the left side of the drawing shows the time variation of the measured position of the vehicle as measured by the cigar-socket type device every second (hereinafter referred to as "cigar-socket type device measured position"). The figure shows the time variation of the measured position in one cigar-socket type device measurement data.

The right side of the drawing shows the time variation of the estimated ETC2.0 measurement positions that are selected from the cigar-socket type device measurement positions and become data elements of the estimated ETC2.0 measurement data. Each of the hatched rectangles is an estimated ETC2.0 measurement position.

As an example, this section illustrates a method for generating estimated ETC2.0 measurement data based on the location information contained in the travel information.

[0083]

This cigar-socket type device measurement data is denoted as "D1", and the cigar-socket type device measurement position included in the cigar-socket type device measurement data "D1" is denoted as "D1(p(t))" (t: time).

The estimated ETC2.0 measurement data is denoted as "D2" and the estimated ETC2.0 measurement position included in this estimated ETC2.0 measurement data is denoted as "D2(p(t))" (t: time).

[0084]

As an example, the following figure shows the measured position as two-dimensional position information excluding the direction of elevation (height direction) (a bird's-eye view of the measured position). The same can be applied to three-dimensional position information.

The measurement positions shown in the figure are for illustrative purposes only and are not necessarily exact.

[0085]

From the perspective of the aforementioned ETC2.0 personal information protection, the processing unit 110, for example, excludes from processing the travel information within "500 m" from the starting point of travelling and the travel information within "500 m" from the ending point of travelling among the cigar socket type device measurement positions. Or, if travel information within these ranges is included in the measurement data, it shall be deleted.

[0086]

The processing unit 110 then selects, for example, the first cigar socket-type device measurement position D1 ($p(1)$) outside the 500 m range from the starting point of travelling, and makes this the first estimated ETC 2.0 measurement position D2 ($p(1)$). In addition, information such as speed, acceleration, angular velocity, etc. of the cigar socket-type device measurement data corresponding to that time is obtained, for example.

[0087]

Next, the processing unit 110 selects the first cigar socket-type device measurement location D1 ($p(q)$) that deviates from the 200 m radius circle based on unit distance (hereinafter referred to as the "unit circle" for convenience) centered at cigar socket-type device measurement location P11 on the time axis., and makes it the second estimated ETC2.0 measurement location D2 ($p(2)$). In addition, information such as speed, acceleration, angular velocity, etc. of the cigar socket-type device measurement data corresponding to that time is obtained, for example.

[0088]

Hereafter, the processing unit 110 repeats this process, and by selecting the cigar socket type device measurement positions [D1($p(1)$), D1($p(q)$), D1($p(r)$), D1($p(s)$), ...], the estimated ETC2.0 measurement positions [D2($p(1)$), D2($p(2)$), D2($p(3)$), D2 ($p(4)$), ...] are obtained. Information such as velocity, acceleration, angular velocity, etc. can be obtained in the same way.

The data that associates these travel information with time can then be used as estimated ETC2.0 measurement data.

[0089]

Thus, basically, based on the ETC 2.0 specification, the travel information can be obtained from the cigar socket-type device measurement data based on unit distance to be the estimated ETC 2.0 measurement data.

[0090]

The example shown here is that the processing unit 110 performs processing with a unit distance of "200 m." However, depending on the specifications of ETC 2.0, the unit distance may be set to "100 m" as described above, or the like.

[0091]

The processing unit 110 may vary the unit distance depending on the road type and speed zone. For example, if the road type is "expressway," the unit distance may be longer than that of the road type "general road" because the driver may drive relatively steadily, though at high speed. Conversely, the unit distance may be shorter than the road type "general road", considering the risk of high-speed driving.

Similarly for speed zones, the higher the speed zone, the longer (or shorter) the unit distance may be.

Road types and speed zones can be identified, for example, from road type information.

[0092]

The estimated ETC2.0 measurement data is generated here by selecting travel information contained in the cigar socket-type device measurement data based on distance (unit distance), but is not limited to this.

Alternatively, or in addition to this, the estimated ETC2.0 measurement data may be generated by selecting travel information contained in the cigar socket-type device measurement data based on time. Specifically, for example, the estimated ETC2.0 measurement data may be generated by calculating the time required to travel a unit distance based on the speed information included in the cigar socket-type device measurement data and selecting travel information for the corresponding time based on the calculated time.

The estimated ETC2.0 measurement data may be generated in the same manner by assuming that the vehicle travels at a constant speed (e.g., 60 km/h) and calculating the time required to travel the unit distance.

[0093]

As mentioned above, ETC2.0 has specifications such that travel information is recorded when, for example, the vehicle's direction of travel changes by more than "45 degrees". Therefore, at least one of the following conditions may be additionally applied to obtain travel information.

However, it is not necessarily mandatory to apply these conditions.

[0094]

(1) of Fig. 7 shows condition A, which relates to changes in the vehicle's direction of travel (bearing or heading).

In this example, if the cigar socket-type device measurement position D1 ($p(u)$) has changed by more than a threshold angle (or more than a threshold angle) relative to the most recent past cigar socket-type device measurement position or the average of the most recent past multiple cigar socket-type device measurement positions, then D1 ($p(u)$) is selected as the estimated ETC2.0 measurement position. This corresponds to

cases such as when the vehicle's direction of travel has changed significantly. The threshold angle can be set to a value such as "45 degrees".

In other words, the measurement position in the vicinity of the position where there is a change of more than or equal to the threshold angle with respect to the direction of travel may be selected as appropriate.

[0095]

The example shown here is that the processing unit 110 performs processing with a threshold angle of "45 degrees," but it may also perform processing with a threshold angle of "22.5 degrees" as described above, etc., depending on the ETC 2.0 specifications.

[0096]

(2) of Fig. 7 shows condition B, which is based on the distance traveled by the vehicle. In this example, if the first cigar socket-type device measurement location D1 ($p(n)$) outside the unit circle is more than the threshold distance (or more than the threshold distance) from the cigar socket-type device measurement location D1 ($p(m)$) selected as the estimated ETC 2.0 measurement location one location earlier, then cigar socket-type device measurement position D1 ($p(n)$) is not selected. The threshold distance can be set to a value that is difficult to assume as the distance the vehicle will travel from one previously selected point based on the speed of the vehicle calculated based on the cigar socket-type device measurement data or a predetermined vehicle speed (e.g., 60 km/h).

[0097]

In other words, a distance margin can be provided, and if it is within the distance margin, the travel information is selected, but if it is not within the distance margin, the travel information is not selected.

[0098]

In this case, for example, the measurement position D1 ($p(n-1)$) one position before D1 ($p(n)$) may be selected as the estimated ETC2.0 measurement position.

For example, the next measurement position D1 ($p(n)$) after measurement position D1 ($p(n)$) may be selected as the estimated ETC2.0 measurement position.

In other words, the measurement position near the edge of the unit circle may be selected as appropriate. The range of the selection criteria is not limited to the unit circle, but may be any range (e.g., ellipse, rectangle, etc.) based on the location of the reference data.

[0099]

For example, the estimated ETC 2.0 measurement position may be calculated by obtaining the average (which may be either an arithmetic average or a weighted average) of the measurement position D1 ($p(n)$) and the measurement position D1 ($p(m)$). Furthermore, it is not limited to calculating the average. For instance, a position that is divided between the measurement position D1 ($p(n)$) and the measurement position D1 ($p(m)$) at an arbitrary ratio (e.g., 2:1) may also be used as the estimated ETC 2.0 measurement position. Alternatively, any method that obtains a value between

measurement positions $D1(p(n))$ and $D1(p(m))$ can be used, without any specific limitations on the content.

[0100]

The same process may be performed with respect to the conditions in (2) of Fig. 7 with a time margin instead of a distance margin.

[0101]

In the ETC 2.0 specification, peak values are recorded when either the front/rear acceleration, left/right acceleration, or yaw angular velocity exceeds a threshold value, as described above. Conditions may be set to reproduce this, and travel information may be selected based on the acceleration and angular velocity information contained in the cigar socket-type device measurement data.

[0102]

Although the method of generating estimated ETC2.0 measurement data based on position information is illustrated above, it may be alternatively or in addition to this method, for example, to generate estimated ETC2.0 measurement data based on speed and time information in the same way.

[0103]

Mathematically, the estimated ETC2.0 measurement data generated as described above can be said to be in a relationship encompassed by the cigar socket-type device measurement data.

The estimated ETC2.0 measurement data generated in this way can be used to generate a driving score model with high validity.

[0104]

That is, a sequence of data generated by extracting a portion of a sequence of measurement data measured and acquired by a device based on some condition may be at least a portion of the sequence of estimated data for the target device. And the condition for extracting the part may be arbitrary, for example, it may be a distance condition, a time condition, an azimuth condition, or any combination thereof.

For example, as shown in (1) of Fig. 8, if there is a column of measured data [$D1(1)$, $D1(2)$, $D1(3)$, $D1(4)$, ...; columns of gray squares, numbers indicate column numbers] by the first device, which is the device to be measured, then based on the following conditions for example The columns of estimated data [$D2(1)$, $D2(2)$, $D2(3)$, $D2(4)$, ...; columns of white circles, where the numbers indicate the column numbers] may be at least partially extracted.

Distance condition: for example, when $D2(t) = D1(s)$ (in (1) of Fig. 8, $D2(1) = D1(3)$), $D2(t+1)$ is the closest $D1(s+x1)$ or the farthest $D1(s+y1)$ within a unit distance away from $D1(s)$ (in (1) of Fig. 8, $D2(2) = D1(6)$).

Time condition: for example, when $D2(t) = D1(s)$ (in Fig. 8(1), $D2(1) = D1(3)$), $D2(t+1)$ is the nearest $D1(s+x2)$ or $D1(s+y2)$ with the largest amount of time elapsed within a unit time from $D1(s)$ (in (1) of Fig. 8, $D2(2) = D1(6)$).

Azimuth angle condition: for example, when $D2(t) = D1(s)$ (in Fig. 8(1), $D2(2) = D1(6)$), $D2(t+1)$ is the nearest $D1(s+x3)$ from the position where the first change of a given azimuth angle or greater occurs in the point sequence starting at $D1(s)$ (in (1) of Fig. 8, $D2(3) = D1(8)$).

where $s, t, x1, y1, x2, y2, x3, y3$ are natural numbers respectively.

[0105]

Or, for example, as shown in (2) of Fig. 8, instead of extracting a portion from the measured data of the first device, data between the measured data may be generated using interpolation, extrapolation, etc., and the generated data may be at least a portion of the estimated data of the second device. Further, for example, as described below, a proximate function may be generated for the sequence of measured data of the first device, and the sequence of estimated data of the second device may be obtained based on arguments that satisfy specified conditions for that proximate function (e.g., per unit distance, per unit time, per unit change in azimuth angle). For example, as in the example shown in (2) of Fig. 8, the approximation function corresponding to the sequence of data in $D1$ may be obtained so that $D2(1)$ is located between $D1(1)$ and $D1(2)$, $D2(2)$ between $D1(4)$ and $D1(5)$, and $D2(3)$ between $D1(7)$ and $D1(8)$.

[0106]

That is, at least a portion of the estimated data of the second device may be generated by extracting a portion of the sequence of measured data by the first device based on some condition, or an approximation function may be generated for the sequence of measured data by the first device and the estimated data of the second device based on some condition-based argument. At least a portion of the estimated data of the second device may be generated.

[0107]

Returning to Fig. 5, the first driving score model processing unit 113, for example, calculates the driving score using the cigar socket-type device measurement data as input to the first driving score model.

[0108]

The second driving score model generation unit 115 generates a second driving score model by using the estimated ETC 2.0 measurement data estimated by the ETC 2.0 measurement data estimation unit 111 and the driving score (training driving score) calculated by the first driving score model processing unit 113 as a training dataset, and performing training (for example, supervised learning) for the first driving score model. The completed training results in the trained second driving score model.

[0109]

(2) During inference

As shown in (2) of Fig. 5, the processing unit 110 of the server 100 has, for example, a trained second driving score model processing unit 117 as a functional part.

The trained second driving score model processing unit 117 can be a type of the trained second model processing unit 17 in (2) of Fig. 2.

[0110]

The trained second driving score model processing unit 117, for example, uses the ETC2.0 measurement data stored in the ETC2.0 measurement database 194 as input to the trained second driving score model to calculate driving scores.

In other words, the trained second driving score model processing unit 117 uses the ETC2.0 measurement data measured by the ETC2.0 on-board device actually installed in the vehicle as input, infers the driving score using the trained second driving score model, and outputs the result of the inference, the driving score inference result.

[0111]

The first driving score model can be, for example, an existing driving score model. Here, the cigar socket-type device measurement data input to the first driving score model processing unit 113 includes, for example, measured travel information such as vehicle position, acceleration (speed when integrated over time), and angular velocity (direction when integrated over time). Therefore, the cigar socket-type device measurement data reflects the driver's driving situation, and the driving score calculated by the first driving score model processing unit 113 may reflect the driver's driving situation. This can be used as supervisory data for training.

[0112]

In addition, as explained in the principle of embodiment, for example, the estimated ETC2.0 measurement data may be used as input data to the first driving score model, and some data corresponding to the first device measurement data measured by various first devices including cigar socket type devices, which have been accumulated in the past, may be used as training data to generate the second driving score model. The second driving score model may be generated by machine learning or other means using some data as training data.

The training data in this case is only an example, but may be data related to vehicle accidents (existence of accidents, number of accidents (frequency, percentage), etc.).

[0113]

<Processing>

Fig. 9 is a flowchart showing an example of the driving score model process flow executed by the processing unit 110 of the server 100 in this example.

First, the processing unit 110 of the server 100 performs the training dataset generation process.

In the training data set generation process, the processing unit 110 performs Loop B processing (S1-S7) for each processed cigar socket-type device measurement data. The cigar socket-type device measurement data to be processed can be, for example, the cigar socket-type device measurement data stored in the cigar socket-type device measurement database 192 under similar conditions (e.g., same measurement period, same road type, same region, etc.). However, it is not limited to this.

[0114]

In the processing of Loop B, the processing unit 110 generates estimated ETC2.0 measurement data based on said cigar socket-type device measurement data (S3). The processing unit 110 then stores the generated estimated ETC2.0 measurement data in the estimated ETC2.0 measurement database 194 in association with the relevant cigar socket-type device measurement data (e.g., in association with identification information (data number, etc.) of the relevant cigar socket-type device measurement data).

The processing unit 110 also calculates a training driving score based on said cigar socket-type device measurement data and the first driving score model (S5). Then, the processing unit 110 stores the calculated training driving score in the storing unit 190 in association with the relevant cigar socket-type device measurement data.

The processing unit 110 then moves on to the next cigar-socket type device measurement data.

[0115]

If S3 and S5 have been processed for all cigar socket-type device measurement data to be processed, the processing unit 110 terminates processing of loop B (S7).

[0116]

The processing unit 110 then performs the training process (S9). Specifically, the model is trained based on the respective estimated ETC2.0 measurement data stored in the estimated ETC2.0 measurement database 194 and the corresponding training driving scores (with the same identification information of the cigar socket-type device measurement data), and a trained second driving score model is generated.

[0117]

Next, the processing unit 110 performs inference processing (S11). Specifically, the second driving score is calculated based on the trained second driving score model generated in S9 and the ETC2.0 measurement data for each processing target (e.g., each ETC2.0 measurement data stored in the ETC2.0 measurement data). The calculated result is then used as the result of quantity inferences.

The processing unit 110 then terminates the process.

[0118]

The step S11 may be omitted and the process may be continued until the second driving score model is generated.

Alternatively, only step S3 may be used to generate estimated ETC2.0 measurement data based on the cigar socket type device measurement data.

[0119]

The processing unit 110 may display the calculated value of the second driving score (inference result) on the display 130.

Instead of or in addition to displaying the calculated second driving score value itself on the display 130, the processing unit 110 may display information such as driver ranks (order-related information), classified based on the calculated second driving score value, on the display 130. Specifically, for example, the following rank information may be displayed on the display 130.

In descending order of rank, "5 stars, 4 stars, 3 stars, 2 stars, 1 star."

Ranked in descending order: "◎, ○, △, ×".

In descending order of rank, "A (A-rated), B (B-rated), C (C-rated)"

Ranks are, in descending order, "Gold, Silver, Bronze."

[0120]

For example, the insurance company that obtains these information from the server 100 may present the calculated premiums to the customer along with the value and rank of the customer's second driving score.

[0121]

Based on the cigar socket-type device measurement data, the processing unit 110 may estimate how much G is applied in which direction due to the driver's acceleration/deceleration, left/right handling operations, etc., and display this information graphically on the display unit 130.

[0122]

<Effect of the first embodiment>

In this embodiment, the estimated ETC2.0 measurement data is generated by selecting travel information from the cigar socket-type device measurement data based on, for example, unit distance or unit time, as described above.

In this case, it can be considered that the aforementioned information on sudden deceleration, sudden acceleration, etc. may not always be accurately reflected in the estimated ETC2.0 measurement data (so-called near-misses, etc. are reflected).

However, the inventor has found that the estimated ETC2.0 measurement data generated as described above can be used to obtain estimated ETC2.0 measurement data that reflects the driver's general driving tendencies (e.g., tends to drive safely, tends to drive dangerously, etc.), resulting in a highly valid driving score model. The results of this study show that it is possible to generate a driving score model with high validity.

[0123]

In this example, the server 100 (an example of an information processing apparatus) is equipped with a processing unit 110 that generates estimated ETC2.0 measurement data, which is estimated data of ETC2.0 measurement data (an example of a second device different from the first device) measured by a device such as an ETC2.0 on-board unit (an example of a second device different from the first device) based on cigar socket type device measurement data (an example of first measurement data) including travel information measured by the device such as a cigar socket type device (an example of first device). The processing unit 110 generates estimated ETC2.0 measurement data, which is estimated data of ETC2.0 measurement data (an example of second measurement data) measured by a device such as an ETC2.0 on-board device (an example of second measurement data).

This allows the generation of estimated second measurement data based on the first measurement data measured by the first device that measures information about the

mobility, which is measured by a second device that measures information about the mobility and is different from the first device.

[0124]

In this case, the sampling unit for measuring data may be different for a device such as a cigar socket device (an example of the first device) and an ETC2.0 on-board unit (an example of the second device).

This makes it possible to generate estimated data for the second measurement data measured by the second device that measures information about the mobility, based on the first measurement data in which information about the mobility is measured by the first device of the two devices with different sampling units.

[0125]

In this case, the sampling unit for a device such as a cigar socket device (an example of the first device) may be time, and the sampling unit for an ETC2.0 on-board unit (an example of the second device) may be distance.

This makes it possible to generate estimated data for the second measurement data, which is measured by the second device whose sampling unit is distance, based on the first measurement data in which information about the mobility is measured by the first device whose sampling unit is time.

[0126]

In this case, a device such as a cigar socket type device (an example of the first device) may measure at predetermined time intervals, and an ETC2.0 on-board unit (an example of the second device) may measure at predetermined distance intervals.

This allows the generation of estimated data for the second measurement data, which is measured by the second device that measures information about the mobility at predetermined distance intervals, based on the first measurement data measured by the first device that measures information about the mobility at predetermined time intervals.

[0127]

The device, such as a cigarette socket-type device (an example of a first device), may measure at predetermined time intervals, and the ETC 2.0 on-board unit (an example of a second device) may measure at predetermined distance intervals. The processing unit 110 of the server 100 may generate estimated ETC 2.0 measurement data (an example of estimated data) based on the cigarette socket-type device measurement data (an example of first measurement data), the predetermined distance intervals measured by the ETC 2.0 onboard unit, and a predetermined condition.

This makes it possible to properly generate estimated data based on the first measurement data, the predetermined distance interval, and the predetermined condition.

[0128]

In this case, the predetermined condition may include at least a condition regarding a change in the direction of the mobility based on the position included in the cigar socket type device measurement data (an example of the first measurement data).

This makes it possible to generate estimation data that takes into account (reflects) changes in the direction of the mobility based on the positions included in the first measurement data.

[0129]

A model for calculating quantities may be generated based on the processing unit 110 of the server 100 and the estimated ETC 2.0 measurement data (an example of estimated data).

This allows for the appropriate generation of models for calculating quantities based on the estimated data.

[0130]

In this case, the processing unit 110 of the server 100 may generate a model such as a driving score model by machine learning using at least the estimated ETC2.0 measurement data (an example of estimated data) as data for training.

This allows the generation of models that can appropriately calculate quantities based on the estimated data.

[0131]

In this case, the processing unit 110 of the server 100 may be configured to calculate various quantities, such as the driving score, based on the ETC 2.0 measurement data and the generated models, such as the driving score model.

This allows quantities to be calculated appropriately based on the second measurement data and the generated model.

[0132]

In this case, the cigar socket type device (an example of the first device) and the ETC2.0 on-board unit (an example of the second device) measure travel information, the quantities are driving scores for the insurance of the mobile vehicle for which the travel information is measured, and the model is a second driving The model may be a score model.

This allows a model to be generated to calculate the driving score based on the second measurement data.

[0133]

In this case, the processing unit 110 of the server 100 may generate a second driving score model using machine learning, where the estimated ETC 2.0 measurement data (an example of estimated data) and the driving score based on the cigarette socket-type device measurement data (an example of first measurement data) are used as training data.

This makes it possible to generate a highly valid model for calculating driving scores based on the second measurement data.

[0134]

<Variation (1)>

In the above example, the first and second devices may be reversed to perform the same process.

[0135]

Specifically, for example,

First device: ETC2.0 on-board device

Second device: Cigar socket type device

and the cigar socket-type device measurement data may be estimated based on the ETC2.0 measurement data.

[0136]

In other words, including the above example, one sampling unit between the first and second devices may be time and the other may be distance. One of the first and second devices may be measured at predetermined time intervals and the other at predetermined distance intervals.

[0137]

<Variation (2)>

The above example is not limited to generating estimated ETC 2.0 measurement data based on travel information in a time series of discrete cigar socket-type device measurement data.

A continuous function that approximates the travel information contained in the cigar socket-type device measurement data may be calculated, and the estimated ETC2.0 measurement data may be generated based on the calculated function.

[0138]

For example, based on the time-series two-dimensional position information contained in the cigar-socket type device measurement data, a two-dimensional position (X, Y) function " $(X, Y) = f(t)$ " is obtained with time "t" as a parameter.

Then, for example, the estimated ETC2.0 measurement data is generated by calculating the time required to travel the unit distance from the speed information contained in the cigar socket-type device measurement data, and calculating the position information at the corresponding time "t" from the function " $(X, Y) = f(t)$ " based on the calculated time. The estimated ETC 2.0 measurement data may be generated by calculating the position information at the corresponding time "t" from the function " $(X, Y) = f(t)$ ".

The same can be applied to three-dimensional location information.

[0139]

By assuming that the vehicle travels at a constant speed (e.g., 60 km/h) and calculating the time required to travel a unit distance, the estimated ETC2.0 measurement data may be generated using the function " $(X, Y) = f(t)$ " in the same manner.

[0140]

<Variation (3)>

In the above example, the second driving score model generation unit 115 may generate the driving score model by performing the training using at least the estimated ETC 2.0 measurement data and the ETC 2.0 measurement data as training data.

[0141]

Specifically, for example, the driving score model may be generated by supervised learning in which the training driving score and the ETC2.0 measurement data are used as the training data and the estimated ETC2.0 measurement data is used in addition to these as the training data set.

[0142]

In this variation, the processing unit 110 of the server 100 generates a model by machine learning using at least the estimated ETC 2.0 measurement data (e.g., an example of estimated data) and the ETC 2.0 measurement data (e.g., an example of second measurement data) as training data.

This allows for a more accurate model to be generated.

[0143]

<Variation (4)>

The validity of the estimation of ETC 2.0 measurement data described in the above example may be verified.

Specifically, for example, the ETC2.0 measurement data obtained by having a driver drive a vehicle equipped with an ETC2.0 on-board unit under similar conditions and the estimated ETC2.0 measurement data generated as in the example above are acquired.

The processing unit 110 of the server 100 may then calculate a value indicating the correlation of these measurement data (correlation value), and if, for example, the correlation value is determined to be not less than (or greater than) a predetermined threshold value (when the two are determined to be correlated), the estimation of the ETC2.0 measurement data may be determined to be valid.

In this case, the validity can be more appropriately verified by performing the above process on a certain number of data.

[0144]

The driving score model generated as in the above example may also be verified.

Specifically, the ETC2.0 measurement data obtained by having a driver drive a vehicle equipped with an ETC2.0 on-board unit under similar conditions, for example, as described above, and the estimated ETC2.0 measurement data generated as in the example above are acquired. The processing unit 110 of the server 100 then compares the driving score obtained by inputting the ETC2.0 measurement data into the driving score model with the driving score obtained by inputting the estimated ETC2.0 measurement data into the driving score model, and if the difference between these driving scores is less than a predetermined threshold value (or), the driving score model may be judged to be valid.

In this case, the validity can be more appropriately verified by performing the above process on a certain number of data.

[0145]

<Variation (5)>

There may be a case where a user signs an automobile insurance contract with an insurance company, but changes (switches) the device installed in the automobile from the first device (e.g., a cigar socket device) to the second device (e.g., an ETC2.0 on-board unit) in the middle of the contract period, or for some other reason.

[0146]

In this case, the processing unit 110 of the server 100 may calculate a driving score for continuing the automobile insurance based on estimated data derived from the measurement data of the first device during the first period, from the start of the contract period (from the insurance start date to the end date (maturity date)) to the date of device change (for example, the first device measurement data measured from the insurance start date to the date of device change), and the measurement data of the second device during the second period, from the device change to the end of the contract period (for example, the second device measurement data measured from the date of device change to the date of driving score calculation (renewal procedure date)), if the device installed in the automobile (used for measurement of data) is changed from the first device to the second device during the insurance contract period.

[0147]

In this case, for example, the driving score may be calculated by any of the following methods.

The first score value calculated by inputting the estimated data (e.g., estimated ETC 2.0 measurement data) into the trained second driving score model and the second score value calculated by inputting the second device measurement data (e.g., ETC 2.0 measurement data) into the trained second driving score model are averaged or otherwise calculated.

Input the integrated data of the estimated data (e.g., estimated ETC 2.0 measurement data) and the second device measurement data (e.g., ETC 2.0 measurement data) into the trained second driving score model for calculation.

[0148]

Instead of using the estimated data based on the first device measurement data during the first period from the start of the contract period to the device change, the first device measurement data during the first period from the start of the contract period to the device change may be used. In this case, for example, the driving score may be calculated by the following method:

Calculate the average of the first score value, which is obtained by inputting the first device measurement data (e.g., cigarette socket-type device measurement data) into the first driving score model, and the second score value, which is obtained by inputting the second device measurement data (e.g., ETC 2.0 measurement data) into the trained second driving score model.

[0149]

<Second Embodiment>

In the first embodiment, for example, examples related to telematics insurance products were described. However, when developing services based on ETC 2.0, including services for such telematics insurance products, it is necessary to evaluate how many people can use the service, the size of the market, and whether the service can be provided fairly nationwide. The second embodiment is an example related to this evaluation.

The contents described in the second embodiment can be applied to any of the other embodiments or other variations.

[0150]

<Data Configuration>

Fig. 10 shows an example of the information stored in the storing unit 190 of the server 100 in this embodiment.

The storing unit 190 stores, for example, the first ETC2.0 service evaluation support processing program 197, which is read by the processing unit 110 and executed as ETC2.0 service evaluation support processing, the aforementioned cigar socket-type device measurement database 192, the roadside unit information database 198, and the histogram creation database 199 are stored.

[0151]

The cigar socket-type device measurement database 192 can store the measurement data of multiple drivers for each measurement period, for example, as described above. The measurement period can be, for example, a monthly period (1 month, 2 months, ..., 6 months, etc.) or any other unit of time. The data may also be classified and stored, for example, by road type or by region.

[0152]

The roadside unit information database 198 is a database that stores information including, for example, location information of roadside units nationwide.

[0153]

The histogram creation database 199 is a database in which histogram data created by the processing unit 110 is stored for evaluation and other purposes related to ETC 2.0-based services, as described below.

[0154]

The aforementioned estimated ETC2.0 measurement database 194, etc., may be stored in the storing unit 190.

[0155]

<Specifications of ETC2.0 on-board device>

In ETC2.0, for example, probe information including travel information is collected from ETC2.0 on-board device at roadside units, as described above.

On the other hand, ETC2.0 on-board device may only be able to record travel information for a predetermined distance, such as a maximum of "80 km," and the travel information beyond the predetermined distance may be discarded without being recorded. Therefore, if a vehicle equipped with an ETC2.0 on-board device does not pass

near a roadside unit for a long time, the travel information that has been recorded may not be collected at the roadside unit.

[0156]

Note that ETC 2.0 specifications may be updated in the future.

For example, the aforementioned unit distance (e.g., 200 m) may be changed, and in some cases, it may be necessary to increase the memory of the ETC2.0 on-board device. However, the proposed method can accommodate such changes in ETC 2.0 specifications, and only requires adjustment of the values of various parameters.

[0157]

<Processing>

Fig. 11 shows an example of the flow of the first ETC 2.0 service evaluation support process performed by the processing unit 110 of the server 100 in this embodiment. The processing unit 110 performs the following processing on each of the cigar socket-type device measurement data contained in the cigar socket-type device measurement database 192, for example.

[0158]

First, the processing unit 110 performs the following processing on the travel information contained in the relevant cigar socket-type device measurement data, for example, in order from the oldest travel information in chronological order.

The processing unit 110 determines whether or not the measured position of the vehicle in the travel information is included in the area of the roadside unit (new roadside unit) (S21).

[0159]

The area in the vicinity of a roadside unit is referred to here as the "roadside unit area". The roadside unit area can be set, for example, as an area within a radius of 5 meters or 10 meters from the location of the roadside unit.

Specifically, the processing unit 110 determines whether or not the measured position of the vehicle included in the travel information is included in the roadside unit area of that roadside unit based on the location information of the roadside unit stored in the roadside unit information database 198.

[0160]

If it is determined that it is included (S21: YES), the processing unit 110 determines whether the measured position of the vehicle is more than "80 km" from the position of the one previous roadside unit (S23).

[0161]

If it is determined that it exceeds the limit (S23), the processing unit 110 sets the transmission flag (collection flag) "ON" to the set of travel information contained in the relevant cigar socket-type device measurement data that is within "80 km" backward from the location of the roadside unit in question (S25).

[0162]

The transmission flag can be a flag that simulates the transmission of travel information to a roadside unit when a vehicle equipped with an ETC2.0 on-board unit passes in the vicinity of a roadside unit.

In this example, in order to evaluate ETC2.0-based services, data measured by a cigar socket-type device (acquired cigar socket-type device measurement data) is used to virtually reproduce (simulate) the transmission of travel information (collection of travel information at a roadside unit) when a vehicle equipped with an ETC2.0 on-board unit passes near a roadside unit. The transmission of travel information (collection of travel information at the roadside unit) is reproduced (simulated) when a vehicle equipped with an ETC2.0 on-board unit passes near a roadside unit.

[0163]

For example, if the measured position of the vehicle included in the relevant travel information is "100 km" away from the position of the previous roadside unit, according to the aforementioned ETC2.0 specifications, the travel information for "20 km" beyond "80 km" from the position of the previous roadside unit is discarded from the ETC2.0 onboard device. To reproduce this, in the step of S25, the transmission flag "ON" is set for the set of travel information within "80 km" from the location of the roadside unit concerned, excluding the portion exceeding "80 km".

[0164]

On the other hand, if it is determined that the distance is not more than "80 km" from the location of the one previous roadside unit (S23: NO), the processing unit 110 sets the transmission flag "ON" for the set of travel information from the location of the one previous roadside unit among the travel information included in the relevant cigar socket-type device measurement data (S27).

[0165]

After S25 or S27, the processing unit 110 determines whether to terminate the process (S29), and if it determines to continue the process (S29: NO), the process returns to S1. On the other hand, if it is determined that the process should be terminated (S29: YES), then the processing unit 110 terminates the first ETC2.0 service evaluation support process.

[0166]

<Setting the measurement period>

Fig. 12 shows an example of a histogram for ETC 2.0 service evaluation generated by the processing unit 110 of the server 100 based on the processing results of the first ETC 2.0 service evaluation support process described above in this example.

[0167]

Based on the above processing results, for example, the processing unit 110 creates a histogram for each measurement period of cigar socket-type device measurement data, where the horizontal axis (class) is the estimated collection time at the roadside unit (h) and the vertical axis (frequency) is the number of vehicles (units).

Since the assumed collection time at the roadside unit can be derived, for example, from the travel information (set of travel information) for which the transmission flag is set to "ON," it can be said to be practically synonymous with the number of data that could be collected at the assumed roadside unit. For this reason, the horizontal axis may be set as the number of assumed collected data.

The vertical axis may also be the number of runs (times).

[0168]

This figure shows an example of a histogram for a measurement period of "one month." As an example, the horizontal axis shows the intervals of the estimated collection time at the roadside unit divided by "1h" as a class. On the vertical axis, the number of vehicles in each interval is shown as a frequency. The total number of vehicles is the sum of the number of vehicles in all segments. The values on the horizontal and vertical axes are only examples and are not limited to these values.

[0169]

Fig. 13 shows an example of a histogram created in the same way for the measurement period "2 months". The view of the figure is the same as in Fig. 12.

[0170]

For example, the processing unit 110 sets the threshold value of the estimated collection time as "3h" and calculates the ratio of the number of vehicles to the total number of vehicles whose estimated collection time exceeds the threshold value of "3h" (hereinafter referred to as the "vehicle count ratio"). The "vehicle count ratio" is calculated as follows. Suppose that the percentage of the number of vehicles is calculated based on the histogram of the measurement period "1 month" in Fig. 12, for example, "60%", and the percentage of vehicles is calculated based on the histogram of the measurement period "2 months" in Fig. 13, for example, "80%".

[0171]

For example, if "75%" is set as the target value for the vehicle count ratio when the assumed collection time threshold is "3h", the vehicle count ratio does not reach the target value for the measurement period "1 month" in Fig. 12, but the vehicle count ratio reaches the target value for the measurement period "2 months" in Fig. 13.

Therefore, in this example, if the cigar socket-type device measurement data with a measurement period of "2 months" is used, it can be determined that there is no problem in reproducing the ETC 2.0 measurement data.

[0172]

In the actual process, the processing unit 110 of the server 100, for example, creates a histogram by updating the measurement periods in the order of shortest to longest until the vehicle count ratio reaches the target value. When the vehicle count ratio reaches the target value, the measurement period is set as the measurement period to be operated.

In this case, for example, among the sets of cigar-socket type device measurement data for each measurement period stored in the cigar-socket type device measurement

database 192 of storing unit 190, only the set of cigar-socket type device measurement data for the set measurement period may be retained, and the sets of cigar-socket type The sets of cigar socket-type device measurement data for other measurement periods may be deleted.

[0173]

The processing unit 110 can then generate the estimated ETC 2.0 measurement data described in the first embodiment using, for example, a set of cigar socket-type device measurement data for the set measurement period to generate the driving score model. In this way, it is possible to create a telematics insurance policy product with guaranteed reliability.

[0174]

Further, the following process may be used.

If processing unit 110 sets, for example, a period of "2 months" as the measurement period for the cigar socket-type device measurement data, the driving score model is generated using the cigar socket-type device measurement data for this "2 months" measurement period. Similarly, the processing unit 110 generates a driving score model using the estimated ETC2.0 measurement data for this "2 months" measurement period in the same manner.

Then, the processing unit 110 determines whether a similar result is obtained when the specified measurement data are input to these generated driving score models (e.g., whether the difference between the models is less than (or equal to) the specified threshold value), and if similar results are obtained, then the measurement data used to calculate the driving score (the Set the measurement period of the ETC2.0 measurement data (used to evaluate driving) to "2 months").

[0175]

On the other hand, if a similar result is not obtained, then the measurement period of the ETC2.0 measurement data used to calculate the driving score (used to evaluate driving) may not be "2 months," so the processing unit 110 may set the measurement period of the ETC2.0 measurement data used to calculate the driving score to a measurement period longer than "2 months". The measurement period of the ETC2.0 measurement data used to calculate the driving score may be set to a period longer than "2 months" (e.g., any of the periods from "3 months" to "6 months").

[0176]

This is because the method generates estimated ETC2.0 measurement data by thinning out (resampling) the travel information in the cigar socket-type device measurement data, and therefore, it may not be reasonable to apply the measurement period of the cigar socket-type device measurement data directly to the ETC2.0 measurement data. This is because there is a possibility that the measurement period of the ETC2.0 measurement data may not necessarily be the same as that of the cigar-socket device measurement data.

Therefore, as described above, the two driving score models may be compared and verified, and the measurement period of the ETC2.0 measurement data used to calculate the driving score may be set (determined) based on the results of the comparison and verification.

[0177]

<Evaluation of the business of insurance products>

The histogram created by server 100 as described above can also be used to evaluate the success or failure of ETC 2.0-based insurance products as a business.

[0178]

When considering the creation of insurance products based on ETC2.0 travel information, it is necessary to have users actually drive vehicles equipped with ETC2.0 on-board device and collect the measurement data. As mentioned above, this has the problem that it is costly, and if it is found that the ETC2.0 system is not capable of collecting sufficient travel information, the insurance product may not be viable as a business in the first place. In other words, as mentioned above, it is assumed that data loss will occur when a vehicle equipped with an ETC2.0 on-board unit travels more than, say, "80 km" without passing near a roadside unit. This will not be known until actual demonstration tests are conducted by vehicles equipped with ETC2.0 on-board device.

[0179]

Therefore, for example, the estimated collection time for each vehicle is calculated based on data collected by other means not using ETC2.0 (e.g., cigar socket device measurement data) and location information of roadside units in the area covered by the telematics insurance (e.g., metropolitan area). Then, it is possible to evaluate how much travel information is hypothetically collected by the roadside unit (or, conversely, how much travel information is discarded) for all vehicles to be covered, using the aforementioned histogram or the like.

[0180]

Specifically, the processing unit 110 of the server 100 creates a histogram of how much travel information is collected per month, for example, based on the cigar socket-type device measurement data for a given measurement period, similar to Figures 12 and 13. The processing unit 110 of the server 100 can then set a threshold value (e.g., 7h, 10h, etc.) for the estimated collection time at the roadside unit, and if the number of vehicles (or ratio of vehicles) whose estimated collection time is above (or exceeds) the threshold value is above (or exceeds) the set value, then the business is established as a general insurance product.

[0181]

In this case, for example, a period of "1 month" may be processed as the predetermined measurement period, or a period of "2 months" or "3 months" may be processed as the predetermined measurement period. In this case, the estimated collection time for the given measurement period may be used as it is, or the estimated collection time per month may be used.

Alternatively, a histogram may be created from cigar-socket device measurement data from multiple different measurement periods, and the time calculated by averaging the estimated collection time for each measurement period, etc. may be used.

[0182]

Instead of the estimated collection time, the aforementioned estimated number of data to be collected may be used.

The same process may be based on the number of data (estimated number of discarded data) or time (estimated discard time) indicating how much travel information was hypothetically discarded without being collected by the roadside unit. This can be viewed as information indicating the percentage (degree) of data loss in the estimated ETC2.0 measurement data (estimated ETC2.0 measurement data generated based on the cigar socket-type device measurement data) (data loss percentage information (data loss degree information)).

[0183]

Judging the success or failure of the above insurance product as a business can also be said to be judging the validity of the estimated ETC2.0 measurement data generated based on the cigar socket-type device measurement data (pseudo ETC2.0 measurement data generated based on cigar socket-type device measurement data) based on the above data loss ratio information. The validity of the estimated ETC2.0 measurement data (i.e., the pseudo ETC2.0 measurement data generated based on the cigar socket-type device measurement data) can also be said to be determined based on the data loss ratio information above.

[0184]

In this case, the server 100 may or may not actually generate the estimated ETC2.0 measurement data. In other words, the server 100 may generate the estimated ETC2.0 measurement data based on the cigar-socket type device measurement data and then determine the validity of the generated estimated ETC2.0 measurement data using the method described above, or it may not generate the estimated ETC2.0 measurement data and generate the estimated ETC2.0 measurement data based on the cigar-socket type device measurement data. In the case where the estimated ETC2.0 measurement data is generated based on the cigar socket device measurement data without generating the estimated ETC2.0 measurement data, the validity of the generated estimated ETC2.0 measurement data may be determined using the method described above.

[0185]

If it is determined that the business is viable as a general insurance product, the processing unit 110 of the server 100 may set the measurement period based on the method described in <Setting the measurement period> above, and then use the set of cigar socket-type device measurement data for the set measurement period to generate the estimated ETC2.0 measurement data may be used to generate the driving score model.

[0186]

Conversely, if the processing unit 110 of server 100 determines that the business is not viable as a general insurance product business, it may do one of the following:

Estimated ETC2.0 measurement data is not generated

Estimated ETC2.0 measurement data is generated but not to be used

[0187]

In the above <Setting the measurement period> and <Evaluation of the business of insurance products>, the processing unit 110 of the server 100 may use the estimated ETC2.0 measurement data instead of the cigar socket-type device measurement data to make the same evaluation.

[0188]

<Effect of the second embodiment>

In this embodiment, the server 100 transmits the ETC2.0 measurement data (an example of the second measurement data) from the ETC2.0 on-board device (an example of the second device) to a roadside unit (an example of the third device) installed at a predetermined location and, based on the cigar socket-type device measurement data (an example of the first measurement data) and the roadside unit location information Based on the estimated ETC2.0 measurement data, it is determined whether or not to generate the estimated ETC2.0 measurement data.

This allows appropriate decisions to be made on whether or not to generate estimated data for the second measurement data based on the first measurement data and the location information of the third device installed at a predetermined position.

[0189]

In this embodiment, the server 100 transmits the ETC2.0 measurement data (an example of the second measurement data) from the ETC2.0 on-board device (an example of the second device) to a roadside unit (an example of the third device) installed at a predetermined location, and the cigar socket type device measurement data (an example of the first measurement data) and the location information of the roadside unit and The system determines whether to use the estimated ETC2.0 measurement data generated based on the

This allows appropriate decisions to be made on whether or not to use the estimated second measurement data based on the first measurement data and the location information of the third device installed at a given position.

[0190]

In this embodiment, the server 100 determines the measurement period of the cigar socket-type device measurement data used to generate the ETC 2.0 measurement data (an example of the second measurement data), which is transmitted from the ETC 2.0 on-board unit (an example of the second device) to the roadside unit (an example of the third device) installed at a predetermined location, based on the cigar socket-type device measurement data (an example of the first measurement data) and the location information of the roadside unit.

This allows appropriate determination of the measurement period of the first measurement data to be used to generate estimated data for the second measurement data, based on the first measurement data and the location information of the third device installed at a given position.

[0191]

This embodiment includes a server 100 equipped with a processing unit 110 that determines the measurement period of the cigarette socket-type device measurement data necessary for the evaluation of driving based on ETC 2.0 measurement data collected by the ETC 2.0 on-board unit, using the cigar socket-type device measurement data measured by the cigar socket-type device.

This enables appropriate determination of the measurement period of the first measurement data required to evaluate the operation based on the first measurement data measured by the first device that measures information about the mobility and the second measurement data measured by the second device, which is different from the first device and measures information about the mobility. The first measurement data can be used for the evaluation of operation based on the second measurement data.

[0192]

In this case, the server 100 determines the measurement period of the ETC 2.0 measurement data necessary to evaluate driving based on the ETC 2.0 measurement data based on the cigar socket-type device measurement data for the measurement period determined as described above.

This allows the measurement period of this second measurement data, which is necessary to evaluate the operation based on the second measurement data, to be appropriately determined based on the first measurement data of the measurement period determined as described above.

[0193]

The server 100 generates pseudo ETC2.0 measurement data for a predetermined period based on the cigar socket-type device measurement data, and acquires data loss ratio information in this pseudo ETC2.0 measurement data. The server 100 then determines the validity of this pseudo ETC2.0 measurement data based on the acquired data loss ratio information.

This allows the validity of the pseudo second measurement data generated based on the first measurement data in a given period to be appropriately determined based on the data loss ratio information.

[0194]

<Variation>

In the above embodiment, the server 100 may determine whether a business for leisure insurance products (for leisure use) can be established based on the cigar socket-type device data measured with a destination such as a leisure site (e.g., when located within the leisure area for a predetermined period) and the estimated ETC 2.0 measurement

data, using a similar method as described in the above embodiment. If it is determined that the business can be established, the insurance company may offer special insurance products for leisure use.

[0195]

In this case, as explained in the example above, if the insurance product is determined by the server 100 to be established as a general insurance product based on the evaluation based on the cigar socket type device measurement data and estimated ETC 2.0 measurement data for the metropolitan area and other areas, the insurance company, regardless of whether it is for leisure use or not The insurance company shall uniformly provide a general insurance product that has been determined to be viable.

[0196]

In this case, as described in the above embodiment, if the server 100 determines that a general insurance product can be established based on the evaluation of the cigar socket-type device measurement data and the estimated ETC 2.0 measurement data in areas such as the metropolitan area, the insurance company may uniformly offer the general insurance product that has been determined to be viable, regardless of whether it is for leisure use or not.

[0197]

<Third Embodiment>

In collecting travel information under the ETC2.0-based system, more travel information can be expected to be collected if new roadside units (ITS spots) that acquire travel information from ETC2.0-compliant devices installed in vehicles are installed. Therefore, the following is an example of measuring the degree of collection of travel information under the ETC2.0-based system, assuming that a new roadside unit is placed in addition to existing roadside unit, and judging the feasibility of ETC2.0-related services based on the measured degree of collection. The following is a third embodiment.

The contents described in the third embodiment can be applied to any of the other embodiments or other variations.

[0198]

<Data Configuration>

Fig. 14 shows an example of the information stored in the storing unit 190 of the server 100 in this embodiment.

The storing unit 190 stores, for example, a support processing program 201 for the second ETC 2.0 service evaluation, which is read by the processing unit 110 and executed as an ETC 2.0 service evaluation support processing, map information 202, a roadside unit information database 198, a cigar socket-type device measurement database 192 and a new roadside unit installation feasibility database 203.

[0199]

The map information database 201 is a database that stores information including, for example, national road information, topography, etc.

[0200]

The roadside unit information database 198 is a database that stores information including, for example, location information of roadside units nationwide, as described above.

【0201】

The cigar socket-type device measurement database 192 is a database that accumulates and stores cigar socket-type device measurement data, including, for example, travel information measured by cigar socket-type devices installed in vehicles, as described above.

In this embodiment, it is assumed that the travel information includes at least location information,

[0202]

The new roadside unit installation feasibility database 203 stores location information of facilities where new roadside units can be installed, for example. Preferably, each location information is associated with information on the nature of the facility (e.g., name of a shopping mall, gas station, convenience store, etc.), and based on the associated nature information, it is possible to extract a set of a certain type of business (gas station, etc.) operated by the same company. It is possible to extract a set of business types (e.g., gas stations) operated by the same company based on the linked property information.

[0203]

Fig. 15 shows an example of the distribution on the map of ETC 2.0 roadside units already located, generated by referring to the information stored in the map information database 201 and the roadside unit database 198. In this embodiment, for each roadside unit, the area information that serves as a guide to the range of acquisition locations of travel information that is likely to be collected is also displayed. It is preferable that such area information is stored in advance or calculated based on the location information of each roadside unit and surrounding road information in the process of deriving the location of new roadside units as described below. The details of the area information are described below.

As shown in Fig. 15, the location of the roadside unit is indicated by a diamond shape superimposed on the map information. As described above, the roadside unit acquires the travel information stored in a vehicle equipped with an ETC2.0 compatible device when the vehicle is located near the roadside unit. With reference to the area information, for each roadside unit, a circle with a radius of a predetermined length r centered on the position where the roadside unit is located is depicted.

The predetermined length r that serves as the radius in the reference range may be 80 km, which is the maximum amount of travel information that can be recorded in an ETC2.0 on-board unit, or, in consideration of the fact that the vehicle travels a distance of 80 km, including curves, etc., a circle with a radius of less than 80 km (e.g., 50 km) from the roadside unit may be used as a reference range. Furthermore, multiple reference ranges may be indicated, for example, by indicating two circles, one with a

radius of 80 km and the other with a radius of less than 80 km in length. The reference range may be an arbitrary range based on the roadside unit location, rather than a circle centered on the roadside unit location. For example, the range may be calculated as a distance of 80 km from the roadside unit position, reflecting the actual road distance in consideration of curves in the road, etc., and such a range may be indicated.

[0204]

Ultimately, if roadside units were installed everywhere, it would be possible to collect travel information without omission, but cost difficulties limit the number of roadside units to be installed.

In addition, new roadside units could be installed at private business facilities, for example, by cooperating with private companies. For example, the private company could pay for the installation at its own business facility at the private company's expense, in exchange for the data provided by the installed roadside unit.

[0205]

Based on such cooperation, consider the installation of new roadside units at several business facilities operated by such private companies.

Fig. 16 shows information on candidate facilities for installation superimposed in the figure shown in Fig. 15. Specifically, in Fig. 16, for the situation in Fig. 15, shopping mall X, gas station Y, and convenience store Z, for example, are extracted and shown as candidate facilities for installation by referring to the new roadside unit installation feasibility database 203. Of course, the types of candidate facilities are not limited to these, but can be set arbitrarily.

[0206]

The example shown in Fig. 17 shows a hypothetical situation in which a new roadside unit is installed at gas station Y, one of these candidate facilities. As shown in Fig. 17, a hollow diamond is placed at each gas station Y to indicate that it is the location of a new roadside unit, and a dotted line indicates the approximate range of travel information acquisition based on the location of each gas station Y.

[0207]

The situation shown in Fig. 17 can be virtually obtained based on the travel information collected by a method different from that corresponding to ETC 2.0, and by evaluating this information, the feasibility and effectiveness of the services related to ETC 2.0 can be determined. The feasibility and effectiveness of ETC2.0-related services can be determined by evaluating the status of the collection of travel information. These processes are explained in detail below.

[0208]

<Processing>

The following describes the process for obtaining the degree of collection of travel information under the assumed conditions, assuming the installation of a new roadside unit, and the process for evaluating the degree of collection to determine the feasibility of services related to ETC 2.0, etc.

Fig. 18 shows an example of the flow of the second ETC2.0 service evaluation support processing performed by the processing unit 110 of the server 100 in this example. Since the second ETC2.0 service evaluation support process is partially similar to the first ETC2.0 service evaluation support process, the explanation of such similar content is omitted.

Similar to the first ETC2.0 service evaluation support process, the processing unit 110 performs the following processing for each cigar socket-type device measurement data contained in the cigar socket-type device measurement database 192, for example.

[0209]

First, the processing unit 110 performs the following processing on the travel information contained in the relevant cigar socket-type device measurement data, for example, in chronological order from the oldest travel information (of course, from the newest travel information is also acceptable, regardless of the order).

The processing unit 110 determines whether any of the travel information for the predetermined distance (e.g., 80 km) after the said travel information is included in the roadside unit area of an existing roadside unit or a newly installed roadside unit (S31). In other words, as mentioned above, ETC2.0 on-board device may only be able to record travel information for a predetermined distance, such as a maximum of 80 km, and the travel information for the portion exceeding the predetermined distance is not recorded and is discarded. The system determines whether the travel information is finally obtained by the roadside unit or is discarded without being recorded.

[0210]

If it is determined that the roadside unit area is included (S31: YES), the processing unit 110 sets the transmission flag (collection flag) "ON" for the travel information that is determined to be included in the area of the roadside unit area (S32).

[0211]

On the other hand, if it is determined that the roadside unit area is not passed (S31: NO), then no flag is set in the travel information (the transmission flag is "OFF").

[0212]

After S31 or S32, the processing unit 110 determines whether to terminate processing or not (S33). In other words, it determines whether there is any remaining travel information to be processed, and if so, the processing continues; if not, it terminates the processing. (S33: NO), the process returns to S31.

On the other hand, if it is determined that the process is terminated (S33: YES), then the processing unit 110 terminates the second ETC2.0 service evaluation support process.

[0213]

In this embodiment, the judgment criterion is whether or not each travel information passes through the roadside unit area in the subsequent travel information for a predetermined distance, but the judgment criterion is not limited to this, and any judgment criterion based on the position of the roadside unit can be applied. For example, the judgment criterion may be whether or not each travel information is

included in the area that serves as a guideline for the acquisition position range of the travel information described above. For example, it may be used as a judgment criterion whether or not each travel information is included in a range that reflects the actual road distance in consideration of curves in the road, etc., as a range of a predetermined distance (e.g., 80 km) from the roadside unit position.

[0214]

In the third embodiment, as in the second embodiment, information indicating the possible degree of collection (hereinafter referred to as "degree of collection information") is calculated based on the processing results of the second ETC2.0 service evaluation support process described above. For example, a histogram similar to those shown in Figures 12 and 13 in the second embodiment is created. Then, for example, the processing unit 110 sets a threshold value for the assumed collection time as appropriate (e.g., "3h") and calculates the percentage of vehicles whose assumed collection time is above or equal to this threshold value.

[0215]

The method of evaluating the degree of collection information is not limited to the above mentioned threshold of assumed collection time, but any method can be applied. For example, the degree of collection information may be obtained for each region, and an evaluation may be made as to whether the number of regions where the degree of collection is above a predetermined threshold value is above a predetermined value. Furthermore, the degree of collection information may be evaluated by, for example, visually displaying the locations where travel information has been acquired on the map information and allowing the user to visually check the distribution of these locations. This allows the user to evaluate whether travel information is collected in a specific area, whether travel information is collected uniformly in a specific area (or all areas), and so on.

[0216]

<Determination of the viability of predetermined business>

Then, using the collection degree information, such as histograms, created by the server 100 as described above, the feasibility of ETC 2.0 based predetermined business can also be determined, as in the second embodiment.

[0217]

In determining the feasibility of predetermined business, the following judgment method can be applied as an example, not a limitation.

The processing unit 110 sets, for example, a period of "2 months" as the measurement period of the cigar socket-type device measurement data, and the collection degree information calculated based on the measurement data during such measurement period satisfies some condition regarding the implementation of the predetermined business (for example, the threshold value of the estimated collection time is "3h"). If the ratio of the number of vehicles to the total number of vehicles whose estimated collection time exceeds "3 hours" is "75%", which exceeds the threshold of the ratio of the number of

vehicles required for the implementation of the predetermined business of "70%"), the predetermined business is determined to be feasible.

On the other hand, if the conditions are not met, it is determined that it is difficult to establish a predetermined business.

[0218]

For example, multiple installation patterns for new roadside units can be prepared (e.g., Pattern 1: installation at "gas station Y", Pattern 2: installation at "shopping mall X" and "gas station Y", Pattern 3: installation at "shopping mall X", "gas station Y" and " (Pattern 3: Install in "shopping mall X", "gas station Y", and "convenience store Z"), and for each of them, it is possible to determine whether the predetermined business can be conducted or not. In other words, for example, if Pattern 1 is determined to be difficult to establish the prescribed business, but Pattern 2 or Pattern 3 is determined to be feasible, the decision to install a new roadside unit can be made based on Pattern 2 or Pattern 3.

[0219]

<Variation>

In the above embodiment, the difference between the degree of collection information calculated under the hypothetical situation in which a new roadside unit is installed according to Pattern 1, which is a certain combination of roadside units, and the degree of collection information under the hypothetical situation in which a new roadside unit is installed according to Pattern 2, which is a different combination of roadside units than Pattern 1. For example, if the ratio of the number of vehicles to the total number of vehicles whose estimated collection time exceeds 3 hours in Pattern 1 is 75% and the ratio of the number of vehicles to the total number of vehicles whose estimated collection time exceeds 3 hours in Pattern 2 is 70% under the situation where a two-month period is set as the measurement period, the difference between the two patterns is 5 points. This difference of 5 points can be considered as the difference in the effect of installing new roadside units in Pattern 1 and Pattern 2.

[0220]

Furthermore, in the above embodiment, the degree of collection information calculated under the assumed situation where a new roadside unit is installed may be compared with the degree of collection information under the situation where no new roadside unit is installed, and the difference between the two may be determined. For example, if the ratio of the number of vehicles to the total number of vehicles whose estimated collection time exceeds 3 hours in the former case is 75% and the ratio of the number of vehicles to the total number of vehicles whose estimated collection time exceeds 3 hours in the latter case is 65% under the situation where a two-month period is set as the measurement period, the difference is 10 point. This difference of 10 points is the effect of installing a new roadside unit.

[0221]

Furthermore, for example, a combination of new roadside units to be installed may be identified from among the candidate facilities where new roadside units can be installed, using an optimization method that identifies new roadside units that will result in the highest possible degree of collection while installing as few new roadside units as possible. In other words, based on the location information of existing roadside units, location information of candidate facilities where new roadside units can be installed, and travel information, an optimization method, by way of example, not limitation, the steepest descent method, etc., is used to identify the combination of candidate facilities where new roadside units can be installed that will be optimal.

[0222]

Furthermore, for example, in selecting new roadside units to be processed, it is possible to distinguish new roadside units to be installed according to the type of business, region, etc., as described above, for example, "In Region A, the selection is limited to gas station Y and shopping mall X. In Region B, the selection is limited to gas station Y, shopping mall X, and convenience store Z. For example, "in region A, it may be limited to gas station Y and shopping mall X. In region B, it may be limited to gas station Y, shopping mall X, and convenience store Z. Furthermore, any one (or any multiple of them) may be identified as a target for installation of new roadside units. It is also possible to calculate the degree of collection information for a pattern of multiple candidate combinations to find the combination of new roadside unit candidates with the best degree of collection information.

[0223]

Furthermore, there may be cases where the location where a new roadside unit can be installed is almost identical to an existing roadside unit, for example, and not much additional benefit can be expected from the installation of a new roadside unit.

Considering such cases, the degree of collection information may be calculated in a manner that does not include any new roadside units. In other words, based on the location information of existing roadside units, user input, etc., it is possible to identify new roadside units that are not to be included (e.g., a set of "gas station Y" excluding some "gas station Y" identified based on some criteria) and to calculate the degree of collection information in a manner that does not include such new roadside units. The collection degree information may be calculated in a manner that does not include such roadside units. It is also possible to calculate the degree of collection information for multiple patterns, including patterns that do not include such specific roadside units, to find the pattern with the best degree of collection information.

[0224]

<Effect of third embodiment>

In this embodiment, the server 100 calculates the collection degree of said measurement data based on the location of existing roadside units and the location of facilities where new roadside units can be installed, mimicking the manner in which cigar socket-type device measurement data is collected by each roadside unit based on the method

corresponding to ETC 2.0. Based on the degree of collection, the feasibility of a given service related to ETC 2.0 is determined. In addition, the difference in the degree of data collection when new roadside units are installed in different patterns and the difference in the degree of data collection when new roadside units are installed and when they are not installed is determined, and the effect of the difference in the degree of data collection is determined. Furthermore, the combination of candidate facilities to install new roadside units is determined using optimization methods, taking into account the cost of installing roadside units and the high degree of collection.

This allows for evaluation, etc., regarding the degree of collection under the assumption that a new roadside unit is installed without installing a new roadside unit.

[0225]

<Fourth Embodiment>

In collecting travel information under the ETC2.0-based system, more travel information can be expected to be collected by newly installing a roadside unit (ITS spot) that acquires travel information from ETC2.0-compliant devices placed in the vehicle.

Therefore, an example of deriving the location of new roadside unit that can effectively collect travel information under the ETC2.0-based system is described as the fourth embodiment.

The contents described in the fourth embodiment can be applied to any of the other examples or other variations.

[0226]

<Data Configuration>

Fig. 19 shows an example of the information stored in the storing unit 190 of the server 100 in this example.

The storing unit 190 stores, for example, a program 204 for deriving new roadside unit installation locations, which is read by the processing unit 110 and executed as a process for deriving new roadside unit installation locations, a map information database 202, a roadside unit information database 198, a cigar socket-type device measurement database 192 and a new roadside unit installation feasibility database 203.

These data configurations are similar to those in the data configuration in storing unit 190 in the third embodiment, except that the second ETC2.0 service evaluation support processing program 201 has become the new roadside unit installation location derivation processing program 204, so its detailed explanation is omitted.

[0227]

Fig. 15 shows an example of the distribution of already located ETC 2.0 roadside units on the map, generated by referring to the information stored in the map information database 201 and the roadside unit database 198, as described above.

Ultimately, if roadside units were installed everywhere, it would be possible to collect travel information without omission, but this is difficult due to cost and the number of units that can be installed is limited. Therefore, it is necessary to install roadside units in locations where collection efficiency is as high as possible.

In the example shown in Fig. 15, four roadside units are installed, but there is an area near the center of the map that is outside the guideline range for acquiring travel information by each roadside unit, indicating that there is a possibility of many omissions in acquiring travel information in this area.

[0228]

Fig. 20 illustrates the situation assumed when a fifth roadside unit is installed for the situation in Fig. 15. As shown in Fig. 20, the location of the new roadside unit is indicated by a hollow diamond, and a dotted circle indicates the approximate location of the travel information covered by the new roadside unit. In this way, more effective collection of travel information can be expected by installing new roadside units in such a way as to fill in the areas that cannot be covered by the existing roadside units.

[0229]

<New Roadside Unit Installation Location Derivation Processing>

The following is a description of the process used to derive the appropriate location for a new roadside unit.

Fig. 21 is a flowchart showing an example of the flow of the new roadside unit installation location derivation process executed by the processing unit 110 of the server 100 in this example.

[0230]

First, the processing unit 110 of the server 100 identifies the region where the new roadside unit is to be installed (S41). The identification of the region is performed, for example, by receiving a designation of the region by user input via the operation unit 120 or the communication unit 150. For example, the user may specify a range by mouse operation or pinch operation, or may specify an address by text input, such as "3-Chome, C-Cho, B-City, A-Prefecture".

The identification of the area where a new roadside unit is to be installed in step S41 is not limited to the method described above, and any method may be applied. For example, based on the location information of existing roadside units, an area where areas that cannot be fully covered by acquiring travel information by existing roadside units collectively exist may be extracted, and the area may be one of the extracted areas.

[0231]

Next, information as shown in Fig. 20 corresponding to the area identified in S31 is displayed on the display 130 by referring to the map information database 202 and the roadside unit information database 198 (S42). At this time, it is preferable to also display information on the approximate range of travel information acquisition by each roadside unit.

[0232]

Next, the location of the newly installed roadside unit is identified (S43). When identifying the location of the newly installed roadside unit, for example, the user may specify the location based on the information presented on the display 130, etc. (for

example, the user may manually specify a location that does not overlap with the approximate coverage area by the existing roadside unit as much as possible), or the user may specify one of multiple recommended locations based on the location information of the existing roadside unit, etc. The user may specify multiple recommended locations based on the location information of existing roadside units, etc., and have the user specify one of the multiple recommended locations.

The latter case is explained below with several examples.

[0233]

<Locate new roadside units based on existing roadside unit location information>

One example of a method for identifying the location of a new roadside unit is based on the location information of existing roadside units in the vicinity.

[0234]

As a specific method, as an example rather than a limitation, as shown in Fig. 22, the furthest location from each existing roadside unit within the designated area may be identified as the location of the new roadside unit. Alternatively, a score may be set that decreases as the distance from each existing roadside unit increases (e.g., inversely proportional to the length of the distance), and based on the aggregate value of the scores (e.g., the lowest total value), the location of the new roadside unit installation may be identified. Furthermore, a plurality of candidate locations may be derived in this manner, and the plurality of candidate locations may be presented to the user via the display 130, etc., and the user may select one of them to identify it as the installation location of the new roadside unit.

Based on the approximate range of travel information acquisition by each roadside unit, the location farthest from those ranges may be used to identify the installation location of the new roadside unit. Furthermore, the approximate range of travel information acquisition by each roadside unit and the approximate range of travel information acquisition by the new roadside unit (e.g., a circular area of radius s ; s may or may not be the same as r) may be compared, and the installation location of the new roadside unit may be identified by considering the small overlap area.

[0235]

<Identify the location of a new roadside unit based on the density of location information of multiple mobilities obtained separately>

Another example of a method for identifying the location of new roadside units is based on the density of location information of multiple mobilities obtained separately.

[0236]

Fig. 23 shows a further superimposed display based on the density of location information contained in the travel information measured by the cigar-socket type device with reference to the cigar-socket type device measurement database 192 for the situation in Fig. 15. A circle indicates that the location information was observed at a predetermined density (e.g., 20 times/day) or higher, and the larger the circle, the higher the density.

Based on the density of location information as shown in Fig. 23, for example, the location with the highest density may be identified as the installation location of the new roadside unit, and the roadside unit location with the highest density in the approximate range of travel information acquisition by the new roadside unit may be identified as the installation location of the new roadside unit. The roadside unit location with the highest density in the guideline range for acquiring travel information by the new roadside unit may be identified as the new roadside unit installation location.

Furthermore, in a manner similar to the aforementioned method, multiple candidate locations may be derived using the above method and presented to the user via the display unit 130 or similar, allowing the user to select one of them as the installation location for the new roadside unit. Additionally, the installation location of the new roadside unit may be determined by comparing the approximate ranges of driving information acquisition by each existing roadside unit and the new roadside unit, taking into account the minimal overlap of their coverage areas.

[0237]

The location information used in this embodiment is assumed to be included in the travel information stored in the Cigar Socket Type Device Measurement Database 192, but is not limited to this. For example, location information collected by other means may be used. This other means may be by a device that is compatible with ETC 2.0.

[0238]

<Identification based on the location of facilities where new roadside units can be installed>

As another example of a method for identifying the location of new roadside units, facilities where new roadside units can be installed may be identified in advance as candidate installation sites, and the location of new roadside units may be identified from such candidate installation sites.

[0239]

Fig. 24 shows candidate installation sites superimposed in the vicinity of the center of the map shown in Fig. 15. In Fig. 24, for the situation in Fig. 15, shopping malls, gas stations, and convenience stores, for example, are extracted and shown as candidate installation sites by referring to the new roadside unit installation feasibility database 203. Of course, the types of candidate installation sites are not limited to these, but can be set arbitrarily.

In the example shown in Fig. 24, a shopping mall is identified as the location of a new roadside unit to be installed, and a hollow diamond is placed in the shopping mall to indicate that it is a new installation location. The approximate range of the location is indicated by a dotted line.

[0240]

In other words, as shown in Fig. 24, a map of the area where the new roadside unit is to be installed, superimposed on the existing roadside units and the approximate range of travel information locations covered by the existing roadside units, as well as candidate

locations for installation of roadside units, is presented to the user via display unit 130, etc., and one of the candidate locations for installation is selected by the user. The user may select one of the candidate locations to identify it as the installation location of the new roadside unit.

Furthermore, similar to the method described above, the approximate range of travel information locations covered by each existing roadside unit may be compared with the approximate range of travel information locations assumed to be covered by the new roadside unit, and the location of the new roadside unit may be identified by considering the small overlap area.

[0241]

Although the methods for identifying the location of new roadside units are described above, the methods are not limited to these, and any method may be used. For example, the method may be a combination of the methods described above. That is, for example, when the density information of the location where the travel information is acquired and the candidate installation sites information of facilities where roadside unit can be installed are known in advance and superimposed on the map information, multiple candidate installation locations of new roadside unit are derived based on such density information and candidate installation sites information and shown to the user via display unit 130, etc. The user may select one of them to identify the installation location of the new roadside unit.

[0242]

In the above explanation, it was assumed that roadside units have already been installed to some extent, but it is not limited to this, and it is also possible to identify new roadside unit setting locations in areas where no roadside units have been installed. In addition to identifying only one new roadside unit location, it may also identify multiple new roadside unit locations. That is, after identifying one new roadside unit location, the next new roadside unit location may be identified as if it were already in place, or multiple new roadside unit locations may be identified simultaneously based on the factors described above.

[0243]

As in the second embodiment, the degree of travel information acquisition can be compared before and after the installation of the new roadside unit, to determine how much the amount of travel information acquisition is expected to increase, and to evaluate whether the travel information acquisition status is sufficient by comparing the amount of travel information acquired after installation with a threshold value, etc. In other words, it is possible to evaluate whether the travel information acquisition status is sufficient or not. In turn, for example, based on the amount of travel information that is expected to be acquired as a result of the installation of new roadside units, it is possible to determine whether the business of insurance products, etc. is viable.

[0244]

<Effect of Fourth Embodiment>

In this embodiment, the server 100 identifies the location of a new roadside unit based on user input, location information from existing roadside units, the density of location information obtained from multiple mobilities, and the location of facilities where roadside units can be installed.

This allows the effective locations where roadside units that acquire travel information using the ETC2.0-compliant system should be installed to be known in advance, without having to install new roadside units.

[0245]

<Others>

The server 100 in the above example may be configured as a plurality of physically separated servers, such that the first server performs some of the processing described in the above example and the second server performs other processing. The server system may be considered to be composed of multiple servers.

[0246]

The mobility is not limited to four-wheeled vehicles, but can also be a two-wheeled vehicle, personal mobility vehicle, ship, train, flying vehicle, etc., as described above. In this case, the same process as in the above example can be performed with the various measuring devices as the first and second devices mounted on or built into the mobility.

[0247]

The same process as described above may be performed, for example, by setting the measurement target as "sound," the sampling unit of the first device as "time," and the sampling unit of the second device as "frequency," as described above.

The same process as above may also be performed, for example, using information about the living body (blood pressure, pulse rate, heart rate, respiratory rate, body temperature, brain waves, etc.) as the measurement target. In this case, the same processing as above may also be performed, for example, using "time" as the sampling unit for the first device and "frequency" as the sampling unit for the second device.

[0248]

As an example of this application, when an insured user is driving a vehicle, the first device is used to measure the user's biometric information. The server 100 may then generate estimated second device measurement data when the user's biometric information is measured by the second device, based on the first device measurement data in which the biometric information is measured by the first device.

In this case, the travel information of the vehicle driven by this user may be measured by a cigar socket type device, etc., and the server 100 may generate the estimated ETC2.0 measurement data described above. In other words, the insured user and the vehicle may be linked, and the server 100 may generate the estimated biometric data in conjunction with the generation of the estimated ETC2.0 measurement data. The user's health status may then be evaluated in conjunction with the evaluation of the user's driving (driving quality).

The system may be used to generate estimated data on the user's biometric information not only during driving, but also at other times besides driving.

[0249]

The cigar-socket type device measurement data and the ETC2.0 measurement data are obtained from a vehicle equipped with an ETC2.0 on-board unit. Then, in the estimated ETC2.0 measurement data generated based on the cigar-socket type device measurement data, the ratio of how much data is lost to the actual ETC2.0 measurement data may be calculated.

The score calculated by inputting the estimated ETC2.0 measurement data into the second driving score model is compared with the score calculated by inputting the actual ETC2.0 measurement data into the second driving score model, and if the difference is less than (or equal to) the threshold value, the estimated ETC2.0 measurement data determined to be valid.

[0250]

In the above embodiments, various programs and data for various types of processing were stored in the memory unit, and the processing unit read and executed these programs to realize the processing in each of the above embodiments. In this case, the memory unit of each device can be an internal storage device such as ROM, EEPROM, flash memory, hard disk, and RAM, as well as a memory card (SD card), compact flash (registered trademark) card, memory stick, USB memory, CD-RW (optical (optical disk), MO (magneto-optical disk), and the various programs and data described above may be stored in these recording media.

[Description of Signs]

[0251]

100 Servers

110 Processing Unit

120 Operation Unit

130 Display Unit

140 Sound Output Unit

150 Communication Unit

160 Clock Unit

190 Memory Unit

Claims

[Claim 1]

An information processing apparatus comprising:

a data generation section that generates estimated data for second measurement data measured by a second device based on first measurement data measured by a first device that measures information about a mobility, the second device being different from the first device and measuring information about the mobility; and

a model generation section that generates a model for calculating quantities related to the mobility using the second device based on the estimated data,

wherein the data generation section performs generation so that the estimated data for the second measurement data is mathematically subsumed by the first measurement data.

[Claim 2]

The information processing apparatus of claim 1,

wherein the data generation section generates at least a portion of the estimated data for the second measurement data by extracting a portion of the first measurement data based on a predetermined condition, and

the predetermined condition is at least one of a time-related condition, a distance-related condition, and an azimuth-related condition.

[Claim 3]

The information processing apparatus of claim 1, further comprising:

a function generation section that generates a function that approximates the first measurement data based on the first measurement data,

wherein the data generation section generates at least a portion of the estimated data for the second measurement data based on the generated function and arguments based on a predetermined condition.

[Claim 4]

The information processing apparatus of claim 3, wherein the predetermined condition is at least one of a time-related condition, a distance-related condition, and an azimuth-related condition.

[Claim 5]

The information processing apparatus of any of claims 1 to 4, wherein the model generation section generates the model by machine learning using at least the estimated data as training data.

[Claim 6]

The information processing apparatus of claim 5, wherein the model generation section generates the model by machine learning using at least the estimated data and the second measurement data as training data.

[Claim 7]

The information processing apparatus of any of claims 1 to 4, further comprising a calculation section that calculates the quantities based on the second measurement data and the generated model.

[Claim 8]

The information processing apparatus of any of claims 1 to 4, wherein the first device and the second device measure travel information, the quantities are driving score related to an operation of the mobility for which the travel information is measured, and the model is a model for calculating the driving score based on the second measurement data.

[Claim 9]

The information processing apparatus of claim 8, wherein the model generation section generates a model for calculating the driving score by machine learning using the estimated data and information based on the first measurement data as training data.

[Claim 10]

The information processing apparatus of any of claims 1 to 4, wherein the second measurement data is transmitted from the second device to a roadside unit at a predetermined location, the information processing apparatus further comprises a determination section that determines whether or not to generate the estimated data based on the first measurement data and location information of the roadside unit.

[Claim 11]

The information processing apparatus of any of claims 1 to 4, wherein the second measurement data is transmitted from the second device to a roadside unit at a predetermined location, the information processing apparatus further comprises a determination section that determines whether or not to use the estimated data that are generated based on the first measurement data and location information of the roadside unit.

[Claim 12]

The information processing apparatus of any of claims 1 to 4, wherein

the second measurement data is transmitted from the second device to a roadside unit at a predetermined location,

the information processing apparatus further comprises a determination section that determines a measurement period of the first measurement data to be used for generating the estimated data based on the first measurement data and location information of the roadside unit.

[Claim 13]

An information processing method including:

generating estimated data for second measurement data measured by a second device based on first measurement data measured by a first device that measures information about a mobility, the second device being different from the first device and measuring information about the mobility,

generating a model for calculating quantities related to the mobility using the second device based on the estimated data,

wherein

the generating the estimated data includes generating the estimated data of the second measurement data so that the estimated data is mathematically subsumed by the first measurement data.

[Claim 14]

A program for causing a computer to execute:

generating estimated data for second measurement data measured by a second device based on first measurement data measured by a first device that measures information about a mobility, the second device being different from the first device and measuring information about the mobility,

generating a model for calculating quantities related to the mobility using the second device based on the estimated data,

wherein

the generating the estimated data includes generating the estimated data for the second measurement data so that the estimated data is mathematically subsumed by the first measurement data.

[Claim 15]

A trained model for enabling a computer to output quantities related to a mobility using a second device, based on information regarding the mobility obtained by the second device, wherein:

the model is trained based on estimated data of second measurement data measured by the second device, the estimated data being generated based on first measurement data measured by a first device different from the second device, and

the estimated data is generated so that the estimated data of the second measurement data is mathematically subsumed by the first measurement data.

[Claim 16]

An information processing apparatus comprising:

an existing roadside unit location information obtaining section that obtains existing roadside unit location information that is location information of an existing roadside unit that has already been installed and collects information about travelling of a mobility according to an ETC2.0 compatible method,

a first installation candidate facility location information obtaining section that obtains first installation candidate facility location information which is location information of at least one facility where the roadside unit is able to be newly installed,

a travel information obtaining section that obtains travel information that is collected based on a method different from the ETC2.0 compatible method and that includes at least information of a location of the mobility, and

a calculation section that calculates first collection degree information that is regarding a collection degree of when it is assumed that the travel information is collected by the roadside unit corresponding to the existing roadside unit location information and the first installation candidate facility location information according to the ETC2.0 compatible method.

[Claim 17]

An information processing apparatus comprising:

a mobility location information obtaining section that obtains a mobility location information from a first device installed on a mobility based on a method different from an ETC2.0 compatible method,

a density information obtaining section that obtains density information of the mobility location information based on the mobility location information that is obtained, and

an identification section that identifies, based on the density information that is obtained, a location for installing a new roadside unit that acquires travel information according to the ETC2.0 compatible method.