{PTL 1} Japanese Unexamined Patent Application, Publication No. Hei 11-211487

{Summary of Invention}

{Technical Problem}

{0004}

However, in the technology discussed in PTL 1, it is not possible to determine whether or not there is a traffic jam on a road within the toll area, making it impossible to provide a high-convenience service to occupants of vehicles traveling within the toll area.

{0005}

In view of such circumstances, it is an object of the present invention to provide an information processing device, a toll collection system, and a toll collection method that can detect whether or not there is a traffic jam on a road by using measured positions of vehicles.

{Solution to Problem}

{0006}

In order to solve the aforementioned problem, an information processing device, a toll collection system, and a toll collection method of the present invention employ the following solutions.

{0007}

Specifically, an information processing device according to a first aspect of the present invention includes receiving

For example, the positional information of each vehicle is generated on the basis of a GPS signal received from GPS satellites and indicates the position of the vehicle based on the latitude and the longitude thereof.

The predetermined area is, for example, an area where a toll is charged to vehicles traveling therein. The segmented road ranges are each defined by, for example, the latitude and the longitude at the start point of the segmented road, the latitude and the longitude at the end point, and the road width.

{0009}

Based on the positional information received by the receiving means, the calculating means calculates the value indicating the traffic conditions of the vehicles traveling on the road corresponding to the segmented range indicated by the road-range information. Based on the value calculated by the calculating means and the threshold value, the detecting means detects whether or not there is a traffic jam on the road corresponding to the range where calculation is performed by the calculating means.

{0010}

Accordingly, the present invention detects whether or not there is a traffic jam on a road corresponding to each segmented range from the value indicating the traffic conditions calculated on the basis of the positional

segmented range, that is, each segmented road. Thus, for example, if the value indicating the traffic conditions corresponds to the number of vehicles, a threshold value for a road corresponding to a range connected to an intersection can be set to be higher than that for a road corresponding to a range not connected to an intersection, so that vehicles waiting for the traffic lights to change at an intersection are less likely to be detected as being in a traffic jam.

Therefore, the present invention can more accurately detect whether or not there is a traffic jam on a road.

{0015}

In the first aspect, it is preferable that the information processing device further include transmitting means for transmitting, to the vehicles, a detection result indicating whether or not a traffic jam has been detected by the detecting means.

{0016}

With the above configuration, since the transmitting means for transmitting the detection result obtained by the detecting means to the vehicles is further provided, the vehicles can process the transmitted traffic-jam information and issue a notification to the vehicle occupants, thereby enhancing the convenience for the occupants of the vehicles.

{0017}

In the first aspect, it is preferable that the

information processing device further include charging means for determining a toll fee for the vehicles traveling in the predetermined area on the basis of whether or not a traffic jam has been detected on the road by the detecting means.

{0018}

With the above configuration, the charging means determines the toll fee for the vehicles traveling in the predetermined area on the basis of whether or not a traffic jam has been detected on the road. Specifically, for example, the charging means can increase or reduce the toll fee for vehicles traveling on a road with a traffic jam.

Therefore, the present invention can charge the vehicles a toll fee according to the traffic conditions.

{0019}

A toll collection system according to a second aspect of the present invention includes an on-board device that is installed in a vehicle and that generates and transmits positional information indicating the position of the vehicle, and the aforementioned information processing device.

{0020}

Since the above configuration includes the on-board device that is installed in a vehicle and that transmits positional information indicating the running position thereof, and the aforementioned information processing device, it can be detected whether or not there is a traffic jam on a

road by using measured positions of vehicles.

{0021}

A toll collection method according to a third aspect of the present invention is implemented by an information processing device including storage means for storing toll-area information indicating an area where a toll is charged to vehicles, and receiving means for receiving positional information indicating the positions of the vehicles from the vehicles. The method includes a first step of virtually segmenting a road on which the vehicles travel in a predetermined area into multiple segments and calculating a value indicating traffic conditions of the vehicles traveling on the segmented road on the basis of the positional information of the vehicles received by the receiving means; a second step of detecting whether or not a traffic jam has occurred on the road corresponding to one of the segments where the calculation is performed in the first step on the basis of the value indicating the traffic conditions calculated in the first step and a predetermined threshold value; and a third step of determining a toll fee for the vehicles traveling in the area indicated by the toll-area information stored in the storage means on the basis of the detection result obtained in the second step.

{0022}

With the above configuration, it is detected whether or

not there is a traffic jam on a road corresponding to each segmented range from the value indicating the traffic conditions calculated on the basis of the positional information received from the vehicles traveling on the road, thereby allowing for traffic-jam detection on the road by using the measured positions of the vehicles. Therefore, the present invention can determine the toll fee for the vehicles traveling in the toll area in accordance with whether or not there is a traffic jam therein.

{Advantageous Effects of Invention}

{0023}

The present invention has a notable advantage in that it is possible to detect whether or not there is a traffic jam on a road by using measured positions of vehicles.

{Brief Description of Drawings}

{0024}

{Fig. 1} Fig. 1 illustrates the overall configuration of a toll collection system according to a first embodiment of the present invention.

{Fig. 2} Fig. 2 is a block diagram schematically illustrating the configuration of an on-board device according to the first embodiment of the present invention.

{Fig. 3} Fig. 3 is a block diagram schematically illustrating the configuration of a central unit according to the first embodiment of the present invention.

{Fig. 4} Fig. 4 schematically illustrates road segments according to the first embodiment of the present invention.

{Fig. 5} Fig. 5 is a flowchart illustrating the flow of a traffic-jam detecting program according to the first embodiment of the present invention.

{Fig. 6} Fig. 6 is a flowchart illustrating the flow of a traffic-jam detecting program according to a second embodiment of the present invention.

{Description of Embodiments}

{0025}

Embodiments of an information processing device, a toll collection system, and a toll collection method according to the present invention will be described below with reference to the drawings.

{0026}

First Embodiment

A first embodiment of the present invention will be described below.

Fig. 1 is an overall schematic view of a toll collection system 10 according to the first embodiment of the present invention.

As shown in Fig. 1, the toll collection system 10 includes a facility 16 having a central unit 14 serving as an information processing device. The central unit 14 charges a toll to a vehicle 12 traveling through a toll area serving as

a traffic jam on the road.

{0062}

Furthermore, in the central unit 14 according to the first embodiment, since the threshold value used for the traffic-jam detection is set according to each road segment, it can be more simply and accurately detected whether or not there is a traffic jam on the road.

{0063}

Furthermore, since the central unit 14 according to the first embodiment transmits the traffic-jam detection result to each vehicle 12, the convenience for the occupants of the vehicles 12 can be enhanced.

{0064}

Furthermore, since the central unit 14 according to the first embodiment determines a toll fee for the vehicles 12 traveling in the toll area on the basis of the traffic-jam detection result, a toll fee according to the traffic conditions can be charged to the vehicles 12.

{0065}

Second Embodiment

A second embodiment of the present invention will be described below.

{0066}

Because the configurations of a toll collection system 10, an on-board device 20, and a central unit 14 according to

jam detecting section 62 outputs, to the CPU 52, a detection result indicating whether or not there is a traffic jam in each road segment.

{0076}

Although the present invention has been described above with reference to the above embodiments, the technical scope of the invention is not limited to the scope discussed in the embodiments. Various modifications and alterations to the above embodiments are permissible so long as they do not depart from the spirit of the invention, and embodiments in which such modifications and alterations are additionally made are also encompassed within the technical scope of the invention.

{0077}

For example, although a configuration in which the current position of each vehicle 12 is detected by using radio waves from GPS satellites is described in the above embodiments, the present invention is not limited to this configuration. Alternatively, the current position of each vehicle 12 may be detected by using radio waves transmitted from wireless local-area-network (LAN) access points that are set mainly for internet connection and that use a wireless LAN called wireless fidelity (Wi-Fi).

{0078}

Furthermore, when the number of vehicles 12 traveling on

{CLAIMS}

{Claim 1}

An information processing device comprising:

receiving means for receiving positional information indicating the positions of a plurality of vehicles from the vehicles;

storage means for storing road-range information indicating segmented road ranges obtained by virtually segmenting a road on which the vehicles travel in a predetermined area into multiple segments;

calculating means for calculating a value indicating traffic conditions of the vehicles traveling on the road corresponding to one of the segmented ranges indicated by the road-range information stored in the storage means on the basis of the positional information received by the receiving means; and

detecting means for detecting whether or not a traffic jam has occurred on the road corresponding to the range where the calculation is performed by the calculating means on the basis of the value indicating the traffic conditions calculated by the calculating means and a predetermined threshold value.

{Claim 2}

The information processing device according to Claim 1, wherein the value indicating the traffic conditions includes

at least one of the density of the vehicles traveling on the road corresponding to the segmented range and the speed of the vehicles, the density and the speed being obtained on the basis of the positional information of the vehicles received by the receiving means.

{Claim 3}

The information processing device according to Claim 1 or 2, wherein the threshold value is a value set according to each segmented range.

{Claim 4}

The information processing device according to any one of Claims 1 to 3, further comprising transmitting means for transmitting, to the vehicles, a detection result indicating whether or not a traffic jam has been detected by the detecting means.

{Claim 5}

The information processing device according to any one of Claims 1 to 4, further comprising charging means for determining a toll fee for the vehicles traveling in the predetermined area on the basis of whether or not a traffic jam has been detected on the road by the detecting means.

{Claim 6}

A toll collection system comprising:

an on-board device that is installed in a vehicle and that generates and transmits positional information indicating

the position of the vehicle; and

the information processing device according to any one of Claims 1 to 5.

{Claim 7}

A toll collection method of an information processing device including storage means for storing toll-area information indicating an area where a toll is charged to vehicles, and receiving means for receiving positional information indicating the positions of the vehicles from the vehicles, the method comprising:

a first step of virtually segmenting a road on which the vehicles travel in a predetermined area into multiple segments and calculating a value indicating traffic conditions of the vehicles traveling on the segmented road on the basis of the positional information of the vehicles received by the receiving means;

a second step of detecting whether or not a traffic jam has occurred on the road corresponding to one of the segments where the calculation is performed in the first step on the basis of the value indicating the traffic conditions calculated in the first step and a predetermined threshold value; and

a third step of determining a toll fee for the vehicles traveling in the area indicated by the toll-area information stored in the storage means on the basis of the detection

result obtained in the second step.

{PTL 1} Japanese Unexamined Patent Application, Publication No. Hei 11-211487

{Summary of Invention}

{Technical Problem}

{0004}

However, in the technology discussed in PTL 1, it is not possible to determine whether or not there is a traffic jam on a road within the toll area, making it impossible to provide a high-convenience service to occupants of vehicles traveling within the toll area.

{0005}

In view of such circumstances, it is an object of the present invention to provide an information processing device, a toll collection system, and a toll collection method that can detect whether or not there is a traffic jam on a road by using measured positions of vehicles.

{Solution to Problem}

{0006}

The invention is defined in the independent claims. Some optional features of the invention are defined in the dependent claims. In order to solve the aforementioned problem, an information processing device, a toll collection system, and a toll collection method employ the following solutions.

{0007}

Specifically, an information processing device according to a first technique includes receiving

For example, the positional information of each vehicle is generated on the basis of a GPS signal received from GPS satellites and indicates the position of the vehicle based on the latitude and the longitude thereof.

The predetermined area is, for example, an area where a toll is charged to vehicles traveling therein. The segmented road ranges are each defined by, for example, the latitude and the longitude at the start point of the segmented road, the latitude and the longitude at the end point, and the road width.

{0009}

Based on the positional information received by the receiving means, the calculating means calculates the value indicating the traffic conditions of the vehicles traveling on the road corresponding to the segmented range indicated by the road-range information. Based on the value calculated by the calculating means and the threshold value, the detecting means detects whether or not there is a traffic jam on the road corresponding to the range where calculation is performed by the calculating means.

{0010}

Accordingly, it may be possible to detect whether or not there is a traffic jam on a road corresponding to each segmented range from the value indicating the traffic conditions calculated on the basis of the positional

segmented range, that is, each segmented road. Thus, for example, if the value indicating the traffic conditions corresponds to the number of vehicles, a threshold value for a road corresponding to a range connected to an intersection can be set to be higher than that for a road corresponding to a range not connected to an intersection, so that vehicles waiting for the traffic lights to change at an intersection are less likely to be detected as being in a traffic jam.

Therefore, it may be possible to detect more accurately whether or not there is a traffic jam on a road.

{0015}

In the first aspect, it is preferable that the information processing device further include transmitting means for transmitting, to the vehicles, a detection result indicating whether or not a traffic jam has been detected by the detecting means.

{0016}

With the above configuration, since the transmitting means for transmitting the detection result obtained by the detecting means to the vehicles is further provided, the vehicles can process the transmitted traffic-jam information and issue a notification to the vehicle occupants, thereby enhancing the convenience for the occupants of the vehicles.

{0017}

In the first aspect, it is preferable that the

information processing device further include charging means for determining a toll fee for the vehicles traveling in the predetermined area on the basis of whether or not a traffic jam has been detected on the road by the detecting means.

{0018}

With the above configuration, the charging means determines the toll fee for the vehicles traveling in the predetermined area on the basis of whether or not a traffic jam has been detected on the road. Specifically, for example, the charging means can increase or reduce the toll fee for vehicles traveling on a road with a traffic jam.

Therefore, it may be possible to charge the vehicles a toll fee according to the traffic conditions.

{0019}

A toll collection system according to a second technique includes an on-board device that is installed in a vehicle and that generates and transmits positional information indicating the position of the vehicle, and the aforementioned information processing device.

{0020}

Since the above configuration includes the on-board device that is installed in a vehicle and that transmits positional information indicating the running position thereof, and the aforementioned information processing device, it can be detected whether or not there is a traffic jam on a

road by using measured positions of vehicles.

{0021}

A toll collection method according to a third technique is implemented by an information processing device including storage means for storing toll-area information indicating an area where a toll is charged to vehicles, and receiving means for receiving positional information indicating the positions of the vehicles from the vehicles. The method includes a first step of virtually segmenting a road on which the vehicles travel in a predetermined area into multiple segments and calculating a value indicating traffic conditions of the vehicles traveling on the segmented road on the basis of the positional information of the vehicles received by the receiving means; a second step of detecting whether or not a traffic jam has occurred on the road corresponding to one of the segments where the calculation is performed in the first step on the basis of the value indicating the traffic conditions calculated in the first step and a predetermined threshold value; and a third step of determining a toll fee for the vehicles traveling in the area indicated by the toll-area information stored in the storage means on the basis of the detection result obtained in the second step.

{0022}

With the above configuration, it is detected whether or

not there is a traffic jam on a road corresponding to each segmented range from the value indicating the traffic conditions calculated on the basis of the positional information received from the vehicles traveling on the road, thereby allowing for traffic-jam detection on the road by using the measured positions of the vehicles. Therefore, it is possible to determine the toll fee for the vehicles traveling in the toll area in accordance with whether or not there is a traffic jam therein.

{Advantageous Effects of Invention}

{0023}

Implementation of these techniques may be advantageous in that it is possible to detect whether or not there is a traffic jam on a road by using measured positions of vehicles.

{Brief Description of Drawings}

{0024}

{Fig. 1} Fig. 1 illustrates the overall configuration of a toll collection system according to a first example.

{Fig. 2} Fig. 2 is a block diagram schematically illustrating the configuration of an on-board device according to the first example.

{Fig. 3} Fig. 3 is a block diagram schematically illustrating the configuration of a central unit according to the first example.

{Fig. 4} Fig. 4 schematically illustrates road segments according to the first example.

{Fig. 5} Fig. 5 is a flowchart illustrating the flow of a traffic-jam detecting program according to the first example.

{Fig. 6} Fig. 6 is a flowchart illustrating the flow of a traffic-jam detecting program according to a second example.

{Description of Embodiments}

{0025}

Embodiments of an information processing device, a toll collection system, and a toll collection method will be described below with reference to the drawings.

{0026}

First Embodiment

A first example will be described below.

Fig. 1 is an overall schematic view of a toll collection system 10 according to the first example.

As shown in Fig. 1, the toll collection system 10 includes a facility 16 having a central unit 14 serving as an information processing device. The central unit 14 charges a toll to a vehicle 12 traveling through a toll area serving as

a traffic jam on the road.

{0062}

Furthermore, in the central unit 14 according to the first embodiment, since the threshold value used for the traffic-jam detection is set according to each road segment, it can be more simply and accurately detected whether or not there is a traffic jam on the road.

{0063}

Furthermore, since the central unit 14 according to the first embodiment transmits the traffic-jam detection result to each vehicle 12, the convenience for the occupants of the vehicles 12 can be enhanced.

{0064}

Furthermore, since the central unit 14 according to the first embodiment determines a toll fee for the vehicles 12 traveling in the toll area on the basis of the traffic-jam detection result, a toll fee according to the traffic conditions can be charged to the vehicles 12.

{0065}

Second Embodiment

A second example will be described below.

{0066}

Because the configurations of a toll collection system 10, an on-board device 20, and a central unit 14 according to

jam detecting section 62 outputs, to the CPU 52, a detection result indicating whether or not there is a traffic jam in each road segment.

{0076}

Although the present invention has been described above with reference to the above examples, the technical scope of the invention is not limited to the scope discussed in the examples. Various modifications and alterations to the above examples are permissible so long as they do not depart from the spirit of the invention, and embodiments in which such modifications and alterations are additionally made are also encompassed within the technical scope of the invention.

{0077}

For example, although a configuration in which the current position of each vehicle 12 is detected by using radio waves from GPS satellites is described in the above embodiments, the present invention is not limited to this configuration. Alternatively, the current position of each vehicle 12 may be detected by using radio waves transmitted from wireless local-area-network (LAN) access points that are set mainly for internet connection and that use a wireless LAN called wireless fidelity (Wi-Fi).

{0078}

Furthermore, when the number of vehicles 12 traveling on

{CLAIMS}

{Claim 1}

An information processing device comprising:

receiving means for receiving positional information indicating the positions of a plurality of vehicles from the vehicles;

storage means for storing road-range information indicating segmented road ranges obtained by virtually segmenting a road on which the vehicles travel in a predetermined area into multiple segments;

calculating means for calculating a value indicating traffic conditions of the vehicles traveling on the road corresponding to one of the segmented ranges indicated by the road-range information stored in the storage means on the basis of the positional information received by the receiving means; and

detecting means for detecting whether or not a traffic jam has occurred on the road corresponding to the range where the calculation is performed by the calculating means on the basis of the value indicating the traffic conditions calculated by the calculating means and a predetermined threshold value,

wherein the information processing device is configured for the value indicating the traffic conditions to be the density of the vehicles traveling on the road corresponding to

the segmented range , for the density to be obtained on the basis of the positional information of the vehicles received by the receiving means, and

wherein the information processing device is configured for the threshold value to be a value set according to each segmented range, and for the threshold value for the range connected to an intersection to be set to be higher than the threshold value for the range not connected to an intersection.

{Claim 2}

The information processing device according to Claim 1, further comprising transmitting means for transmitting, to the vehicles, a detection result indicating whether or not a traffic jam has been detected by the detecting means.

{Claim 3}

The information processing device according to Claim 1 or Claim 2, further comprising charging means for determining a toll fee for the vehicles traveling in the predetermined area on the basis of whether or not a traffic jam has been detected on the road by the detecting means.

{Claim 4}

A toll collection system comprising:

an on-board device for installation in a vehicle and for generating and transmitting positional information indicating the position of the vehicle; and

the information processing device according to any one of the preceding claims.

{Claim 5}

A toll collection method of an information processing device including storage means for storing toll-area information indicating an area where a toll is charged to vehicles, and receiving means for receiving positional information indicating the positions of the vehicles from the vehicles, the method comprising:

a first step of virtually segmenting a road on which the vehicles travel in a predetermined area into multiple segments and calculating a value indicating traffic conditions of the vehicles traveling on the segmented road ranges on the basis of the positional information of the vehicles received by the receiving means;

a second step of detecting whether or not a traffic jam has occurred on the road corresponding to the range where the calculation is performed in the first step on the basis of the value indicating the traffic conditions calculated in the first step and a predetermined threshold value; and

a third step of determining a toll fee for the vehicles traveling in the area indicated by the toll-area information stored in the storage means on the basis of the detection result obtained in the second step,

wherein the value indicating the traffic conditions is

the density of the vehicles traveling on the road corresponding to the segmented range, the density being obtained on the basis of the positional information of the vehicles received by the receiving means, and

wherein the threshold value is a value set according to each segmented range, and the threshold value for the range connected to an intersection is set to be higher than the threshold value for the range not connected to an intersection.