Description

Title of Invention

VEHICLE NUMBER DATA PROCESSING SYSTEM, VEHICLE NUMBER DATA PROCESSING METHOD, VEHICLE NUMBER DATA PROCESSING DEVICE, PROGRAM, AND RECORDING MEDIUM

Technical Field

[0001]

The present invention relates to a vehicle number data processing system, a vehicle number data processing method, a vehicle number data processing device, a program, and a recording medium. In particular, the present invention relates to a vehicle number data processing system, a vehicle number data processing method, and a vehicle number data processing device processing vehicle number data including information regarding a vehicle number of a number plate of a vehicle obtained by performing optical character recognition on an image, a program causing a computer to function as the vehicle number data processing device, and a recording medium recording the program.

Priority is claimed on Japanese Patent Application No. 2012-070398, filed March 26, 2012, the content of which is incorporated herein by reference.

Background Art

[0002]

An electronic toll collection system of a toll road is a system in which an integrated circuit (IC) card recording contract information or the like is inserted into

on-board equipment mounted on a vehicle, wireless communication is performed between a roadside antenna installed in a toll gate of a toll road and the on-board equipment, and payment is made by recording information regarding a toll fare or the like on both of a toll road computer system connected to the roadside antenna and the IC card.

[0003]

FIG. 14 illustrates an example of a use environment of an electronic toll collection system 900 of a toll road. A user of the electronic toll collection system 900 needs to mount on-board equipment on a vehicle when using the electronic toll collection system 900. Here, the on-board equipment refers to a wireless device that wirelessly communicates information necessary to charge a toll fare between the on-board equipment and each of roadside antennas 930 and 960. The on-board equipment that processes charging of a toll fare according to a kind of vehicle is mounted on the vehicle.

[0004]

In the electronic toll collection system 900, the roadside antenna 930, a camera 940, a sensor 950, and the roadside antenna 960 are installed in order in the same lane. When a vehicle enters a communication region of the roadside antenna 930 of the lane, the on-board equipment withdraws a toll fare from a balance of electronic money with which an integrated circuit (IC) card inserted into the on-board equipment is charged.

[0005]

Then, when the vehicle enters a detection area of the sensor 950, the sensor 950 detects, for example, the size of the vehicle and transmits data indicating the size to a control device 920. When the control device 920 receives the data transmitted from the sensor 950, the control device 920 specifies, for example, the kind of vehicle based on the size of the vehicle indicated by the data.

[0006]

Then, when the vehicle enters a communication region of the roadside antenna 960, the roadside antenna 960 receives data indicating the toll fare withdrawn from the balance of the electronic money from the on-board equipment and transmits the data to the control device 920.

[0007]

When the control device 920 receives the data transmitted from the roadside antenna 960, the control device 920 determines whether the withdrawn amount of the toll fare indicated by the data is correct as the toll fare of the kind of vehicle specified in the above manner. For example, when the on-board equipment mounted on the vehicle is not on-board equipment according to the kind of vehicle, the toll fare according to the specified kind of vehicle is not withdrawn. Therefore, the control device 920 determines that the withdrawn amount is not correct as the toll fare. Further, for example, the control device 920 also determines that the withdrawn amount is not correct as the toll fare when the balance of the electronic money is short or no on-board equipment is mounted.

[0008]

When the control device 920 determines that the withdrawn amount is not correct as the toll fare and the rear side of the vehicle is detected by the sensor 950, the camera 940 images the rear side of the vehicle and transmits image data to the control device 920. Here, a number plate installed on the rear side of the vehicle is pictured in the image captured by the camera 940. When the control device 920 receives the image data transmitted from the camera 940, the control device 920 transmits the image data to a server 910.

[0009]

When the server 910 receives the image data transmitted from the control device 920, the server 910 performs optical character recognition on the image data to read a vehicle number displayed on the number plate. In this way, a road service provider can specify the vehicle number of an illegal vehicle.

[0010]

Incidentally, the government of Singapore has examined development and introduction of an electronic toll collection system using the Global Positioning System (GPS). In the electronic toll collection system using the GPS, GPS receivers are mounted on all vehicles and entrance to roads is detected by the GPS receivers for charging. Thus, in the electronic toll collection system using the GPS, it is not necessary to provide devices that process charging, thereby resulting in reduction in cost.

[0011]

On the other hand, in the electronic toll collection system using the GPS, it is necessary to separately construct a system that images the number plates of illegal vehicles. However, in the electronic toll collection system using the GPS, illegal vehicles may not be specified as triggers of the results of the charging processes, as in the electronic toll collection system illustrated in FIG. 14. For this reason, for the electronic toll collection system using the GPS, the system that images the number plates of illegal vehicles is required to image the number plates of all vehicles entering roads.

[0012]

Here, when the number plates of all vehicles travelling on a plurality of lanes are attempted to be imaged, cameras imaging the number plates of the vehicles are installed to be lined up in the width direction of the road above the road so that neighboring imaging areas overlap. In this way, by eliminating blind corners between the cameras, a vehicle travelling on a lane is imaged by any camera. Here, a vehicle travelling at a

position at which the imaging areas of two neighboring cameras overlap is imaged by the two cameras.

[0013]

Here, images of the number plates imaged in this way also include images in which the number plates are not the number plates of illegal vehicles. Thus, a superordinate system performs a process of determining whether the number plates pictured in the images are the number plates of the illegal vehicles. Therefore, the image data captured by the cameras is transmitted to the superordinate system.

[0014]

As described above, however, the image data obtained by imaging the number plate of a predetermined vehicle is repeatedly present in the image data captured by the cameras in some cases. Accordingly, when all of the image data captured by the cameras is transmitted to the superordinate system, a network therebetween may be unnecessarily overloaded. Further, the superordinate system may unnecessarily process the repeated image data indicating the number plate of the predetermined vehicle. Accordingly, the system using the plurality of cameras is required to process, as one of data, data indicating the vehicle number of the predetermined vehicle among a plurality of data indicating vehicle numbers of number plates obtained by performing optical character recognition on images captured by the cameras.

[0015]

Various technologies relevant to such circumstances are known (for example, see PLT 1). PLT 1 discloses a moving object recognition method of recognizing an object entering a measurement area, in which imaging regions of a plurality of cameras are connected, through image processing. In the moving object recognition method, a measurement area is set such that the neighboring imaging regions are set to overlap by

only a predetermined width necessary to avoid a recognition error of an object or an element of the object, and an object recognition process is performed based on images simultaneously captured by the cameras. Thus, in the moving object recognition method, the measurement area can be expanded since the imaging regions of the plurality of cameras are set to overlap by the predetermined width in a movement direction of a moving object. Thus, it is possible to improve recognition of a fast moving object or recognition of a plurality of moving objects.

Citation List

Patent Literature

[0016]

PLT 1: Japanese Unexamined Patent Application, First Publication No. H08-005316

Summary of Invention

Technical Problem

[0017]

In the moving object recognition method disclosed in PLT 1, however, complete vehicle number data is generated by aggregating a plurality of vehicle number data, and some pieces of data indicating the vehicle number of the same vehicle, among a plurality of data indicating vehicle numbers of number plates obtained by performing optical character recognition on images imaged by the cameras, are not processed as one piece of data.

Solution to Problem

[0018]

To resolve the above-mentioned problem, according to a first aspect of the present invention, a vehicle number data processing system is provided that processes vehicle number data including information regarding a vehicle number of a number plate of a vehicle obtained by performing optical character recognition on an image. The vehicle number data processing system includes: a plurality of imaging devices which are installed so that imaging areas of the plurality of imaging devices overlap each other and which are configured to continuously capture an image of a road; and a vehicle number data processing device configured to process the vehicle number data. The vehicle number data processing device includes one of a vehicle number data integration unit configured to reserve one of one piece of vehicle number data and another piece of vehicle number data along with deleting the other of the one piece of vehicle number data and the another piece of vehicle number data to thereby integrate the vehicle number data including information regarding the same vehicle, wherein the one piece of vehicle number data include information regarding a vehicle number obtained by performing the optical character recognition on an image captured by one of the imaging devices, and the another piece of vehicle number data include information regarding a vehicle number obtained by performing the optical character recognition on an image captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices.

[0019]

The vehicle number data processing device may further include a same-vehicle-number searching unit configured to retrieve vehicle number data including the same information as information regarding the vehicle number included in vehicle number data obtained by performing the optical character recognition on the image

captured by one of the imaging devices, among vehicle number data obtained by performing the optical character recognition on the images captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices. The vehicle number data integration unit may integrate (i) vehicle number data obtained by performing the optical character recognition on the image captured by one of the imaging devices and (ii) the vehicle number data retrieved by the same-vehicle-number searching unit.

[0020]

The vehicle number data processing device may further include an optical character recognition determination unit configured to determine whether a portion unrecognizable through the optical character recognition is contained in a vehicle number obtained by performing the optical character recognition on the image captured by one of the imaging devices. The same-vehicle-number searching unit may retrieve vehicle number data including the same information as information regarding the vehicle number if the optical character recognition determination unit determines that a portion unrecognizable through the optical character recognition is not contained in the vehicle number.

[0021]

The vehicle number data processing device may further include a vehicle number position determination unit configured to determine whether a position of a vehicle number obtained by performing the optical character recognition on the image captured by one of the imaging devices in the image is within the imaging area of another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices. The optical character recognition determination unit may determine whether a portion unrecognizable through the optical character recognition is

contained in the vehicle number if the vehicle number position determination unit determines that the position of the vehicle number is within the imaging area of another of the imaging devices having the imaging area overlapping the imaging area of one of the imaging devices.

[0022]

The vehicle number data processing device may further include an integrated data determination unit configured to determine whether the vehicle number data is the vehicle number data integrated by the vehicle number data integration unit. The vehicle number position determination unit may determine whether a position of a vehicle number included in the vehicle number data in the image is within the imaging area of another of the imaging devices if the integrated data determination unit determines that the vehicle number data is not the integrated vehicle number data.

[0023]

The vehicle number data processing system may further include a plurality of vehicle number data generation devices installed in one-to-one correspondence with the imaging devices and configured to generate the vehicle number data by performing the optical character recognition on images captured by the corresponding imaging devices. The vehicle number data processing device may further include: a check data reception unit configured to receive check data used to check soundness of a network from the vehicle number data generation devices; a vehicle number data reception unit configured to receive the vehicle number data from the vehicle number data generation devices; and a reception or non-reception determination unit configured to determine, after the vehicle number data reception unit receives the vehicle number data, whether the check data reception unit receives the check data. If the reception or non-reception determination unit determines that the check data reception unit receives the check data after the vehicle

number data reception unit receives the vehicle number data, the integrated data determination unit may determine whether the vehicle number data is the vehicle number data integrated by the vehicle number data integration unit.

[0024]

When the vehicle number data generation device performs the optical character recognition on an image captured by the corresponding imaging device and generates the vehicle number data including the information regarding the vehicle number of the number plate of the vehicle, the vehicle number data generation device may generate the vehicle number data further including information regarding an initial time and information regarding a final time at which the vehicle is detected by the corresponding imaging device. The vehicle number data processing device may further include: a character complementing unit configured to supplement a character of the vehicle number of a portion unrecognizable through the optical character recognition if the optical character recognition determination unit determines that the portion unrecognizable through the optical character recognition is contained in the vehicle number; and a same-period-of-time searching unit configured to retrieve vehicle number data including the information regarding the initial time or the information regarding the final time corresponding to a period of time from the initial time to the final time included in vehicle number data obtained by performing the optical character recognition on the image captured by one of the imaging devices, among vehicle number data obtained by performing the optical character recognition on images captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices, if (i) the optical character recognition determination unit determines that a portion unrecognizable through the optical character recognition is contained in the vehicle number or (ii) the same-vehicle-number searching unit fails to

retrieve c vehicle number data including information regarding the same vehicle number. The same-vehicle-number searching unit may retrieve vehicle number data including the same information as information regarding the vehicle number in which the character is supplemented by the character complementing unit, among the vehicle number data retrieved by the same-period-of-time searching unit.

[0025]

When the vehicle number data generation device performs the optical character recognition on an image captured by the corresponding imaging device and generates the vehicle number data including the information regarding the vehicle number of the number plate of the vehicle, the vehicle number data generation device may generate the vehicle number data further including information regarding a kind of number plate of the vehicle. The vehicle number data processing device may further include a same-kind-of-number-plate searching unit configured to retrieve vehicle number data including the same information as information regarding the kind of number plate included in vehicle number data obtained by performing the optical character recognition on the image captured by one of the imaging devices, among vehicle number data obtained by performing the optical character recognition on images captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices, if the same-vehicle-number searching unit fails to retrieve vehicle number data including information regarding the same vehicle number among the vehicle number data retrieved by the same-period-of-time searching unit. If the same-kind-of-number-plate searching unit retrieves one of vehicle number data, the vehicle number data integration unit may integrate the retrieved vehicle number data and vehicle number data obtained by performing the optical character recognition on the image captured by one of the imaging devices.

[0026]

When the vehicle number data generation device performs the optical character recognition on an image captured by the corresponding imaging device and generates the vehicle number data including the information regarding the vehicle number of the number plate of the vehicle, the vehicle number data generation device may generate the vehicle number data further including information regarding a vehicle speed of the vehicle. The vehicle number data processing device may further include a vehicle speed estimation unit configured to estimate a degree of accordance between the vehicle speed indicated by information included in vehicle number data obtained by performing the optical character recognition on the image captured by one of the imaging devices and the vehicle speed indicated by information included in vehicle number data obtained by performing the optical character recognition on the image captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices, if the same-kind-of-number-plate searching unit retrieves the plurality of vehicle number data. The vehicle number data integration unit may integrate the vehicle number data including information regarding the vehicle speeds of which the degree of accordance estimated by the vehicle speed estimation unit is high.

[0027]

The vehicle number data processing device may further include a period-of-time estimation unit configured to estimate a degree of accordance between a period of time from the initial time to the final time indicated by information included in vehicle number data obtained by performing the optical character recognition on the image captured by one of the imaging devices and a period of time from the initial time to the final time indicated by information included in vehicle number data obtained by performing the optical character recognition on the image captured by another of the

imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices, if the same-kind-of-number-plate searching unit retrieves the plurality of vehicle number data. The vehicle number data integration unit may integrate the vehicle number data including information regarding the times of which the degree of accordance estimated by the period-of-time estimation unit is high.

[0028]

When the vehicle number data generation device performs the optical character recognition on an image captured by the corresponding imaging device and generates the vehicle number data including the information regarding the vehicle number of the number plate of the vehicle, the vehicle number data generation device may generate the vehicle number data further including information regarding a detection position of the vehicle, in regard to detection positions of all vehicles detected during a period of time in which the vehicle is detected by the corresponding imaging device. The vehicle number data processing device may further include a detection position estimation unit configured to estimate a degree of accordance between the detection position indicated by information included in vehicle number data obtained by performing the optical character recognition on the image captured by one of the imaging devices and the detection position indicated by information included in vehicle number data obtained by performing the optical character recognition on the image captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices, if the same-kind-of-number-plate searching unit retrieves the plurality of vehicle number data. The vehicle number data integration unit may integrate the vehicle number data including information regarding the detection positions of which the degree of accordance estimated by the detection position estimation unit is high.

[0029]

The vehicle number data processing device may further include an imaging time determination unit configured to determine whether an imaging time of an image which is being subjected to the optical character recognition by each of the vehicle number data generation devices is a time prior to a final time at which a vehicle included in vehicle number data obtained by performing the optical character recognition on an image captured by one of the imaging devices is detected, if the same-period-of-time searching unit or the same-kind-of-number-plate searching unit fails to retrieve the vehicle number data. If the imaging time determination unit determines that the imaging time is not the time prior to the final time, the vehicle number data integration unit may set vehicle number data obtained by performing the optical character recognition on the image captured by one of the imaging devices as the integrated vehicle number data.

[0030]

According to a second aspect of the present invention, a vehicle number data processing method is provided for processing vehicle number data including information regarding a vehicle number of a number plate of a vehicle obtained by performing optical character recognition on an image. The vehicle number data processing method includes a vehicle number data integration step of reserving one of one piece of vehicle number data and another piece of vehicle number data along with deleting the other of the one piece of vehicle number data and the another piece of vehicle number data to thereby integrate the vehicle number data including information regarding the same vehicle, wherein the one piece of vehicle number data include information regarding a vehicle number obtained by performing the optical character recognition on an image captured by one of the imaging devices installed so that imaging areas of a plurality of the imaging devices overlap each other and configured to continuously capture an image of a road, and the another piece of vehicle number data include information regarding a

vehicle number obtained by performing the optical character recognition on an image captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices.

[0031]

According to a third aspect of the present invention, a vehicle number data processing device is to process vehicle number data including information regarding a vehicle number of a number plate of a vehicle obtained by performing optical character recognition on an image. The vehicle number data processing device includes a vehicle number data integration unit configured to reserve one of one piece of vehicle number data and another piece of vehicle number data along with deleting the other of the one piece of vehicle number data and the another piece of vehicle number data to thereby integrate the vehicle number data including information regarding the same vehicle, wherein the one piece of vehicle number data include information regarding a vehicle number obtained by performing the optical character recognition on an image captured by one of the imaging devices installed so that imaging areas of a plurality of the imaging devices overlap each other and configured to continuously capture an image of a road, and the another piece of vehicle number data include information regarding a vehicle number obtained by performing the optical character recognition on an image captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices.

[0032]

According to a fourth aspect of the present invention, a program is to cause a computer to function as a vehicle number data processing device that processes vehicle number data including information regarding a vehicle number of a number plate of a vehicle obtained by performing optical character recognition on an image. The program

causes the computer to function as a vehicle number data integration unit configured to reserve one of one piece of vehicle number data and another piece of vehicle number data along with deleting the other of the one piece of vehicle number data and the another piece of vehicle number data to thereby integrate the vehicle number data including information regarding the same vehicle, wherein the one piece of vehicle number data include information regarding a vehicle number obtained by performing the optical character recognition on an image captured by one of the imaging devices installed so that imaging areas of a plurality of the imaging devices overlap each other and configured to continuously capture an image of a road, and the another piece of vehicle number data include information regarding a vehicle number obtained by performing the optical character recognition on an image captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices.

[0033]

According to a fifth aspect of the present invention, a recording medium is provided that records a program causing a computer to function as a vehicle number data processing device that processes vehicle number data including information regarding a vehicle number of a number plate of a vehicle obtained by performing optical character recognition on an image. The recording medium records the program causing the computer to function as a vehicle number data integration unit configured to reserve one of one piece of vehicle number data and another piece of vehicle number data along with deleting the other of the one piece of vehicle number data and the another piece of vehicle number data to thereby integrate the vehicle number data including information regarding the same vehicle, wherein the one piece of vehicle number data include information regarding a vehicle number obtained by performing the optical character recognition on an image captured by one of the imaging devices installed so that imaging

areas of a plurality of the imaging devices overlap each other and configured to continuously capture an image of a road, and the another piece of vehicle number data include information regarding a vehicle number obtained by performing the optical character recognition on an image captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices.

[0034]

In the overview of the foregoing present invention, not all of the characteristics necessary for the present invention are enumerated.

Further, sub-combinations of the characteristic groups may serve as the present invention.

Advantageous Effects of Invention

[0035]

As is apparent from the foregoing description, according to the present invention, some pieces of data indicating the vehicle number of the same vehicle, among a plurality of data indicating vehicle numbers of number plates obtained by performing optical character recognition on images imaged by the cameras, can be processed as one piece of data.

Brief Description of Drawings

[0036]

FIG. 1 is a diagram illustrating an example of a use environment of a vehicle number data processing system 100 according to an embodiment.

FIG. 2 is a diagram illustrating an example of the block configuration of a vehicle number data processing device 110.

FIG. 3 is a diagram illustrating an example of information stored in a vehicle number data storage unit 126 in a table format.

FIG. 4 is a diagram illustrating an example of the information stored in the vehicle number data storage unit 126 in the table format.

FIG. 5 is a diagram illustrating an example of the information stored in the vehicle number data storage unit 126 in the table format.

FIG. 6 is a diagram illustrating an example of the information stored in the vehicle number data storage unit 126 in the table format.

FIG. 7 is a diagram illustrating an example of an operation sequence of the vehicle number data processing device 110 and a vehicle number data generation device 150.

FIG. 8 is a diagram illustrating an example of an operation sequence of the vehicle number data processing device 110, a camera 130, and the vehicle number data generation device 150.

FIG. 9 is a diagram illustrating an example of an operation flow of the vehicle number data processing device 110.

FIG. 10 is a diagram illustrating an example of an operation flow of the vehicle number data processing device 110.

FIG. 11 is a diagram illustrating an example of an operation flow of the vehicle number data processing device 110.

FIG. 12 is a diagram illustrating an example of an operation flow of the vehicle number data processing device 110.

FIG. 13 is a diagram illustrating an example of a hardware configuration of a computer 800 configured as the vehicle number data processing device 110 according to the embodiment.

FIG. 14 is a diagram illustrating an example of a use environment of an electronic toll collection system 900 of a toll road.

Description of Embodiments

[0037]

Hereinafter, the present invention will be described according to embodiments of the present invention, but the following embodiments do not limit the present invention described in the claims. All of the combinations of characteristics described in the embodiments may not be indispensable to solutions of the present invention.

[0038]

FIG. 1 illustrates an example of a use environment of a vehicle number data processing system 100 according to an embodiment. The vehicle number data processing system 100 is a system that processes vehicle number data. Here, the vehicle number data refers to data that includes at least information regarding a vehicle number of a number plate of a vehicle obtained by performing optical character recognition on an image.

[0039]

The vehicle number data processing system 100 includes a vehicle number data processing device 110, a plurality of cameras 130a to 130d (hereinafter generally referred to as cameras 130), and a plurality of vehicle number data generation devices 150a to 150d (hereinafter generally referred to as vehicle number data generation devices 150). The camera 130 may be an example of an "imaging device" of the present invention.

[0040]

The vehicle number data processing device 110 is electrically connected to the vehicle number data generation devices 150. The vehicle number data processing

devices process vehicle number data.

[0041]

The cameras 130 are installed to be lined up in the width direction in gates G above a road R10 having a plurality of lanes R11 to R13 so that neighboring imaging areas overlap. In the embodiment, an imaging area Aa of the camera 130a overlaps an imaging area Ab of the camera 130b. In the embodiment, the imaging area Ab of the camera 130b overlaps an imaging area Ac of the camera 130c. In the embodiment, the imaging area Ac of the camera 130c overlaps an imaging area Ad of the camera 130d. The camera 130 is electrically connected to one vehicle number data generation device 150. The cameras 130 image the road R10 continuously while facing obliquely downward.

[0042]

The vehicle number data generation devices 150 are installed in one-to-one correspondence with the cameras 130. Each vehicle number data generation device 150 is electrically connected to the corresponding camera 130. The vehicle number data generation device 150 performs the optical character recognition on an image captured by the corresponding camera 130 and generates vehicle number data including at least information regarding the vehicle number of the number plate of a vehicle obtained by performing the optical character recognition on the image. More specifically, when the vehicle number data generation device 150 performs the optical character recognition on an image captured by the corresponding camera 130 and generates the vehicle number data including information regarding the vehicle number of the number plate of a vehicle, the vehicle number data generation device 150 generates vehicle number data including other information regarding the vehicle in some cases. For example, the vehicle number data generation device 150 generates the vehicle number data further including

information regarding the initial time and information regarding the final time obtained by the corresponding camera 130 detecting the vehicle. The vehicle number data generation device 150 also generates the vehicle number data further including information a kind of number plate of the vehicle. The vehicle number data generation device 150 also generates the vehicle number data further including information regarding a speed of the vehicle. The vehicle number data generation device 150 also generates the vehicle number data further including information regarding a detection position of a vehicle, in regard to detection positions of all of the vehicles at which the vehicles are detected during a period of time in which the vehicle is detected by the corresponding camera 130.

[0043]

In the embodiment, in order to prevent the description from being complicated, a configuration in which the vehicle number data processing system 100 includes one vehicle number data processing device 110 will be described. However, the vehicle number data processing system 100 may include a plurality of vehicle number data processing devices 110.

[0044]

In the embodiment, a configuration in which the vehicle number data processing system 100 includes the plurality of vehicle number data generation devices 150 corresponding to the plurality of cameras 130 will be described. However, the vehicle number data processing system 100 may include one vehicle number data generation device 150 corresponding to a plurality of cameras 130.

[0045]

FIG. 2 illustrates an example of a block configuration of the vehicle number data processing device 110. The vehicle number data processing device 110 includes a

vehicle number data reception unit 112, a check data reception unit 111, a reception or non-reception determination unit 113, an integrated data determination unit 114, a vehicle number position determination unit 115, an optical character recognition determination unit 116, a same-vehicle-number searching unit 117, a same-period-of-time searching unit 119, a character complementing unit 118, a same-kind-of-number-plate searching unit 120, a vehicle speed estimation unit 121, a period-of-time estimation unit 122, a detection position estimation unit 123, an imaging time determination unit 124, a vehicle number data integration unit 125, and a vehicle number data storage unit 126. In the following description, a function and an operation of each constituent element will be described in detail.

[0046]

The vehicle number data reception unit 112 receives vehicle number data from the vehicle number data generation device 150.

[0047]

The check data reception unit 111 receives check data from the vehicle number data generation device 150. Here, the check data refers to data for checking soundness of a network between the vehicle number data processing device 110 and the vehicle number data generation device 150.

[0048]

After the vehicle number data reception unit 112 receives the vehicle number data, the reception or non-reception determination unit 113 determines whether the check data reception unit receives the check data.

[0049]

The integrated data determination unit 114 determines whether the vehicle number data is vehicle number data after integration of the vehicle number data

integration unit 125. More specifically, when the vehicle number data reception unit 112 receives vehicle number data and then the reception or non-reception determination unit 113 determines that the check data reception unit 111 receives the check data, the integrated data determination unit 114 determines whether the vehicle number data is vehicle number data after the integration of the vehicle number data integration unit 125.

[0050]

The vehicle number position determination unit 115 determines whether the position of a vehicle number obtained by performing the optical character recognition on an image captured by one camera 130 in the image is within the imaging area of the camera 130 neighboring the one camera 130. More specifically, when the integrated data determination unit 114 determines that the vehicle number data is not the vehicle number data integrated by the vehicle number data integration unit 125, the vehicle number position determination unit 115 determines whether the position of the vehicle number contained in the vehicle number data in the image is within the imaging area of the neighboring camera 130.

[0051]

The optical character recognition determination unit 116 determines whether a portion unrecognizable through the optical character recognition is contained in the vehicle number obtained by performing the optical character recognition on an image captured by one camera 130. More specifically, when the vehicle number position determination unit 115 determines that the position of the vehicle number is within the imaging area of the camera 130 neighboring one camera 130, the optical character recognition determination unit 116 determines whether the portion unrecognizable through the optical character recognition is contained in the vehicle number.

[0052]

The same-vehicle-number searching unit 117 searches the vehicle number data including the same information as information regarding a vehicle number included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130, among the vehicle number data obtained by performing the optical character recognition on images captured by the camera 130 neighboring the one camera 130. More specifically, when the optical character recognition determination unit 116 determines that the portion unrecognizable through the optical character recognition is not contained in the vehicle number, the same-vehicle-number searching unit 117 searches the vehicle number data including the same information as the information regarding the vehicle number. Further, the same-vehicle-number searching unit 117 searches the vehicle number data including the same information as the information regarding the vehicle number obtained through the character complementing by the character complementing unit 118 among the vehicle number data searched by the same-period-of-time searching unit 119.

[0053]

When the optical character recognition determination unit 116 determines that the portion unrecognizable through the optical character recognition is contained in the vehicle number, the character complementing unit 118 complements a character of the vehicle number of the portion unrecognizable through the optical character recognition.

[0054]

When the optical character recognition determination unit 116 determines that the portion unrecognizable through the optical character recognition is contained in the vehicle number or the same-vehicle-number searching unit 117 may not search the vehicle number data including the information regarding the same vehicle number, the same-period-of-time searching unit 119 searches the vehicle number data including

information regarding the initial time or information regarding the final time corresponding to a period of time from an initial time to a final time included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130, among the vehicle number data obtained by performing the optical character recognition on images captured by the camera 130 neighboring the one camera 130.

[0055]

When the same-vehicle-number searching unit 117 may not search the vehicle number data including the information regarding the same vehicle number among the vehicle number data searched by the same-period-of-time searching unit 119, the same-kind-of-number-plate searching unit 120 searches the vehicle number data including the same information as the information regarding the kind of number plate included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130, among the vehicle number data obtained by performing the optical character recognition on images captured by the camera 130 neighboring the one camera 130.

[0056]

When the same-kind-of-number-plate searching unit 120 searches a plurality of vehicle number data, the vehicle speed estimation unit 121 estimates the degree of accordance between a vehicle speed indicated by information included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 and a vehicle speed indicated by information included in the vehicle number data obtained by performing the optical character recognition on an image captured by the camera 130 neighboring the one camera 130.

[0057]

When the same-kind-of-number-plate searching unit 120 searches the plurality of vehicle number data, the period-of-time estimation unit 122 estimates the degree of accordance between the period of time from the initial time to the final time indicated by the information included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 and the period of time from the initial time to the final time indicated by the information included in the vehicle number data obtained by performing the optical character recognition on an image captured by the camera 130 neighboring the one camera 130.

[0058]

When the same-kind-of-number-plate searching unit 120 searches the plurality of vehicle number data, the detection position estimation unit 123 estimates the degree of accordance between a detection position indicated by information included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 and a detection position indicated by information included in the vehicle number data obtained by performing the optical character recognition on an image captured by the camera 130 neighboring the one camera 130.

[0059]

When the same-period-of-time searching unit 119 or the same-kind-of-number-plate searching unit 120 may not search the vehicle number data, the imaging time determination unit 124 determines whether an imaging time of the image which is being subjected to the optical character recognition by the vehicle number data generation device 150 is a time prior to the final time at which the vehicle included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 is detected.

[0060]

The vehicle number data integration unit 125 integrates the vehicle number data including the information regarding the predetermined vehicle by reserving one of vehicle number data along with deleting the other of the vehicle number data between the vehicle number data including the information regarding the vehicle number obtained by performing the optical character recognition on an image captured by one camera 130 and the vehicle number data including the information regarding the vehicle number obtained by performing the optical character recognition on an image captured by the camera 130 neighboring the one camera 130. More specifically, the vehicle number data integration unit 125 integrates the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 and the vehicle number data searched by the same-vehicle-number searching unit 117.

When the same-kind-of-number-plate searching unit 120 searches one of vehicle number data, the vehicle number data integration unit 125 integrates the vehicle number data searched by the same-kind-of-number-plate searching unit 120 and the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130. The vehicle number data integration unit 125 also integrates the vehicle number data including information regarding vehicle speeds of which the degree of accordance estimated by the vehicle speed estimation unit 121 is high. The vehicle number data integration unit 125 also integrates the vehicle number data including information regarding times of which the degree of accordance estimated by the period-of-time estimation unit 122 is high. The vehicle number data integration unit 125 also integrates the vehicle number data including information regarding the detection positions of which the degree of accordance estimated by the detection position estimation unit 123 is high. When the imaging time determination unit 124 determines that the imaging time is not the time prior to the final time, the vehicle number data

integration unit 125 also sets the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 as the integrated vehicle number data.

[0061]

FIGs. 3 to 6 illustrate an example of information 127 stored in the vehicle number data storage unit 126 in a table format. The vehicle number data storage unit 126 stores information regarding a data identifier (ID), an image ID, a vehicle number, an optical character recognition estimation value, a kind of number plate, the central position of a vehicle number detection region, the central position of a vehicle detection region, a vehicle detection estimation value, a vehicle speed (km/h), an imaging time (year/month/day/hour:minute:second), a camera ID, an initial detection time (year/month/day/hour:minute:second), a final detection time (year/month/day/hour:minute:second), the number of vehicles, a detection position, and a check data reception time (year/month/day/hour:minute:second) and information regarding whether the integration is completed (Yes or No) in association therewith.

[0062]

The information regarding a data ID is information used to uniquely identify each of vehicle number data in the plurality of vehicle number data. More specifically, the information regarding the data ID is information appended when each piece of information included in the vehicle number data is stored in the vehicle number data storage unit 126.

[0063]

The information regarding an image ID is information used to uniquely identify each image among a plurality of images captured by the cameras 130. More specifically, the vehicle number data generation device 150 stores an image in which a vehicle

number marked on the number plate is viewed most easily among images in which the predetermined vehicle is pictured. Here, the image in which the vehicle number marked on the number plate is viewed most easily refers to, for example, an image in which the number plate is pictured largest. The information regarding the image ID is information used to identify the image stored in this way in the vehicle number data generation device 150.

[0064]

The information regarding the vehicle number is information indicating the vehicle number of a vehicle pictured in an image. More specifically, the vehicle number data generation device 150 performs the optical character recognition on an image in which the vehicle number marked on a number plate is pictured more clearly among images in which the predetermined vehicle is pictured and reads characters of the vehicle number marked on the number plate. The information regarding the vehicle number is information which is subjected to the optical character recognition and is read by the vehicle number data generation device 150.

[0065]

The information regarding the optical character recognition estimation value is information indicating the degree of reliability of the optical character recognition result. More specifically, the information regarding the optical character recognition estimation value according to the embodiment is expressed by a decimal of which the maximum value is "1," a larger numerical value of which indicates a higher degree of reliability of the optical character recognition result.

[0066]

The information regarding the kind of number plate is information indicating the kind of number plate of a vehicle pictured in an image. More specifically, the

information regarding the kind of number plate indicates, for example, a number plate describing how many wheels a vehicle has and which stages a vehicle number is marked at.

[0067]

The information regarding the central position of a vehicle number detection region is information indicating the position of a center point of a region, occupied by a vehicle number detected in an image subjected to the optical character recognition, in the image. More specifically, the information regarding the central position of the vehicle number detection region indicates, for example, a position in an orthogonal coordinate system in which the horizontal direction of an image is set as the X axis and the vertical direction of the image is set as the Y axis on the assumption that the top left of the image is a base point.

[0068]

The information regarding the central position of the vehicle detection region is information indicating the position of a center point of a region, occupied by a vehicle detected in an image subjected to the optical character recognition, in the image. More specifically, the information regarding the central position of the vehicle detection region indicates, for example, a position in an orthogonal coordinate system in which the horizontal direction of an image is set as the X axis and the vertical direction of the image is set as the Y axis on the assumption that the top left of the image is a base point.

[0069]

The information regarding the vehicle detection estimation value is information indicating the degree of reliability of a detection result obtained by detecting an object pictured in an image as a vehicle. More specifically, for example, the vehicle number data generation device 150 detects whether an object is a vehicle based on feature points

of the object, excluding a road pictured in an image. The information regarding the vehicle detection estimation value indicates the degree of reliability of the detection result.

[0070]

The information regarding a vehicle speed (km/h) is information indicating a speed of a vehicle pictured in an image. More specifically, a vehicle speed is measured by, for example, a measurement device (not illustrated).

[0071]

The information regarding an imaging time (year/month/day/hour:minute:second) is information indicating a time at which an image is captured. More specifically, the information regarding an imaging time is simultaneously recorded in an image file when the camera 130 captures an image.

[0072]

The information regarding a camera ID is information used to uniquely identify each camera 130 among the plurality of cameras 130. More specifically, the vehicle number data generation device 150 generates vehicle number data including the information regarding a camera ID indicating the corresponding camera 130.

[0073]

The information regarding an initial detection time (year/month/day/hour:minute:second) is information indicating a time at which a vehicle pictured in an image is initially detected. More specifically, the camera 130 continuously captures images in which a vehicle is pictured until the vehicle travelling on the lane R10 enters and passes through the imaging area. The information regarding the initial detection time (year/month/day/hour:minute:second) indicates an imaging time of the initially captured image among the plurality of images in which the predetermined

vehicle is pictured in this way.

[0074]

The information regarding the final detection time (year/month/day/hour:minute:second) is information indicating a time at which a vehicle pictured in an image is finally detected. More specifically, the information regarding the final detection time (year/month/day/hour:minute:second) indicates an imaging time of the finally captured image among the plurality of images in which the predetermined vehicle is pictured, as described above.

[0075]

The information regarding the number of vehicles is information indicating the number of all of the vehicles detected by the camera 130 from initial detection of the vehicles pictured in the images to final detection by the camera 130. More specifically, for example, the camera 130b according to the embodiment images the imaging area Ab extending the lanes R11 and R12. Thus, the camera 130b simultaneously images a vehicle travelling on the lane R11 and a vehicle travelling on the lane R12. For example, when two vehicles have travelled in the imaging area of the lane R12 while the camera 130b detects a vehicle travelling on the lane R11, the camera 130b accordingly detects three vehicles while detecting the vehicle travelling on the lane R11.

[0076]

The information regarding the detection position is information indicating a detection position in the width direction of a vehicle pictured in an image identified by the information regarding the image ID with respect to the detection positions of all of the vehicles detected by the camera 130 in the width direction until the vehicle pictured in the image is initially detected and then finally detected by the camera 130. For example, as described above, when two vehicles have travelled in the imaging area of the

lane R12 while the camera 130b detects a vehicle travelling on the lane R11, the camera 130b accordingly detects three vehicles while detecting the vehicle travelling on the lane R11.

At this time, the detection position in the width direction of the vehicle travelling on the lane R11 is the first vehicle from the left among the three vehicles when viewed in the movement direction.

[0077]

The information regarding the check data reception time (year/month/day/hour:minute:second) is information indicating a time at which the vehicle number data processing device 110 finally receives check data from the vehicle number data generation device 150 when the vehicle number data processing device 110 receives the vehicle number data from the vehicle number data generation device 150. More specifically, the information regarding the check data reception time (year/month/day/hour:minute:second) is information for comparison with the latest check data reception time.

[0078]

The information regarding whether the integration is completed (Yes or No) is information indicating whether the vehicle number data including each piece of information associated with the information regarding the image ID is the integrated data. More specifically, "Yes" information indicating that the integration is completed indicates that the vehicle number data is data after the vehicle number data processing device 110 performs the integration process. On the other hand, "No" information indicating that the integration is not completed indicates that the vehicle number data is data before the vehicle number data processing device 110 performs the integration process.

[0079]

FIG. 7 illustrates an example of an operation sequence of the vehicle number data processing device 110 and the vehicle number data generation device 150. In the description of the operation sequence, processes of transmitting and receiving the check data will be described in detail. The description of the operation flow will be made with reference to FIGs. 1 to 6.

[0080]

The vehicle number data generation device 150 transmits the check data to the vehicle number data processing device 110 (S101). More specifically, for example, the vehicle number data generation device 150 transmits the check data at intervals of a predetermined time. Here, the check data includes information regarding an imaging time of an image which is being subjected to the optical character recognition.

[0081]

When the check data reception unit 111 of the vehicle number data processing device 110 receives the check data transmitted from the vehicle number data generation device 150, the check data reception unit 111 transmits data indicating the reception time to the vehicle number data reception unit 112 and the reception or non-reception determination unit 113. Then, the check data reception unit 111 transmits, to the imaging time determination unit 124, the data indicating the imaging time of the image which is being subjected to the optical character recognition and is included in the check data transmitted from the vehicle number data generation device 150.

[0082]

In this way, the vehicle number data reception unit 112 and the reception or non-reception determination unit 113 of the vehicle number data processing device 110 can perform the process based on the reception time of the latest check data. Further,

the imaging time determination unit 124 of the vehicle number data processing device 110 can perform the process based on the imaging time of the image which is being subjected to the optical character recognition by the vehicle number data processing device 110.

[0083]

FIG. 8 illustrates an example of an operation sequence of the vehicle number data processing device 110, the camera 130, and the vehicle number data generation device 150. In the description of the operation sequence, processes of transmitting and receiving the vehicle number data will be described in detail. The description of the operation flow will be made with reference to FIGs. 1 to 7.

[0084]

The camera 130 captures a video in the imaging area using semiconductor elements responding to light, such as charge-coupled devices (CCDs) or complementary metal oxide semiconductors (CMOSs), (S201) and outputs the video as image data (S202). More specifically, the camera 130 performs imaging at a speed of, for example, about 20 (images/second).

[0085]

When the vehicle number data generation device 150 receives an input of the image data output from the camera 130, the vehicle number data generation device 150 performs the optical character recognition on the image data and generates the vehicle number data (S203). More specifically, when no vehicle is pictured in the image, the vehicle number data generation device 150 destroys the image data. Conversely, when a vehicle is pictured in the image, the vehicle number data generation device 150 stores the image data. Here, as described above, the camera 130 performs the imaging at a speed of about 20 (images/second). Thus, the camera 130 continuously outputs the

image data in which the predetermined vehicle is pictured. When the vehicle number data generation device 150 continuously receives inputs of the image data in which the vehicle is pictured, the vehicle number data generation device 150 deals with the series of image data as image data in which the predetermined vehicle is pictured. Then, the vehicle number data generation device 150 performs the optical character recognition on the image in which the vehicle number marked on the number plate of the vehicle is the clearest within the series of image data. Then, the vehicle number data generation device 150 generates the vehicle number data including information regarding the vehicle number of the number plate of the vehicle obtained through the optical character recognition. At this time, the vehicle number data generation device 150 includes the information regarding the image ID, the optical character recognition estimation value, the kind of number plate, the central position of the vehicle number detection region, the central position of the vehicle detection region, the vehicle detection estimation value, the vehicle speed (km/h), the imaging time (year/month/day/hour:minute:second), the camera ID, the initial detection time (year/month/day/hour:minute:second), the final detection time (year/month/day/hour:minute:second), the number of vehicles (vehicles), and the detection position (vehicle sequence) in the vehicle number data. Then, the vehicle number data generation device 150 transmits the vehicle number data generated in this way to the vehicle number data processing device 110 (S204).

[0086]

When the vehicle number data reception unit 112 of the vehicle number data processing device 110 receives the vehicle number data transmitted from the vehicle number data generation device 150, the vehicle number data reception unit 112 stores the information included in the vehicle number data and the information regarding the data ID in the vehicle number data storage unit 126 in association therewith (S205). At this

time, the vehicle number data reception unit 112 further associates the information regarding the reception time of the check data indicated by the latest data finally received from the check data reception unit 111, as described in step S101 of FIG. 7, and stores this information in the vehicle number data storage unit 126. The vehicle number data reception unit 112 further associates the "No" information indicating that the integration is not completed and stores this information in the vehicle number data storage unit 126.

[0087]

Thus, the information illustrated in FIGs. 3 to 6 is stored in the vehicle number data storage unit 126 of the vehicle number data processing device 110.

[0088]

FIGs. 9 to 12 illustrate an example of an operation flow of the vehicle number data processing device 110. In the description of the operation flow, a process of integrating the vehicle number data will be described in detail. The description of the operation flow will be made with reference to FIGs. 1 to 8.

[0089]

First, after the vehicle number data reception unit 112 receives the vehicle number data, the reception or non-reception determination unit 113 of the vehicle number data processing device 110 determines whether the check data reception unit receives the check data (S301). More specifically, the vehicle number data processing device 110 reads the information regarding a check data reception time (year/month/day/hour:minute:second) of one of vehicle number data among the information stored in the vehicle number data storage unit 126. Then, the reception or non-reception determination unit 113 compares a time indicated by the information with a reception time of the check data indicated by the latest data finally received from the check data reception unit 111, as described in step S101 of FIG. 7. As a result, when the

reception time of the check data indicated by the latest data finally received from the check data reception unit 111 is the same time as the time indicated by the information read from the vehicle number data storage unit 126 (S301: No), the reception or non-reception determination unit 113 waits until a subsequent process.

[0090]

Thus, when the latest reception time of the check data is the same time as the check data reception time associated with the information of the foregoing one of vehicle number data, the vehicle number data processing device 110 does not perform the process of the integrating the one of vehicle number data.

[0091]

Conversely, when the reception time of the check data indicated by the latest data finally received from the check data reception unit 111 is a time later than the time indicated by the information of the foregoing one of vehicle number data read from the vehicle number data storage unit 126 in step S301 (S301: Yes), the reception or non-reception determination unit 113 transmits the data ID of the one of vehicle number data to the integrated data determination unit 114.

[0092]

When the integrated data determination unit 114 of the vehicle number data processing device 110 receives the data ID transmitted from the reception or non-reception determination unit 113, the integrated data determination unit 114 determines whether the foregoing one of vehicle number data identified with the data ID is the vehicle number data integrated by the vehicle number data integration unit 125 (S302). More specifically, the integrated data determination unit 114 reads the information regarding whether the integration of the foregoing one of vehicle number data identified with the data ID received from the check data reception unit 111 is

completed (Yes or No) among the information stored in the vehicle number data storage unit 126. When the value indicated by the information is "Yes" (S302: Yes), the integrated data determination unit 114 waits until a subsequent process.

[0093]

Thus, when the integration of the foregoing one of vehicle number data is completed, the vehicle number data processing device 110 does not perform the process of integrating the one of vehicle number data.

[0094]

Conversely, when the value indicated by the information of the foregoing one of vehicle number data read from the vehicle number data storage unit 126 is "No" in step S302 (S302: No), the integrated data determination unit 114 transmits the data ID of the one of vehicle number data to the vehicle number position determination unit 115.

[0095]

When the vehicle number position determination unit 115 of the vehicle number data processing device 110 receives the data ID transmitted from the integrated data determination unit 114, the vehicle number position determination unit 115 determines whether the position of the vehicle number included in the foregoing one of vehicle number data identified by the data ID in the image is within the imaging area of the neighboring camera 130 (S303). More specifically, the vehicle number position determination unit 115 reads the information regarding the central position of the vehicle number detection region, the central position of the vehicle detection region, and the camera ID of the foregoing one of vehicle number data identified with the data ID received from the integrated data determination unit 114 among the information stored in the vehicle number data storage unit 126. Then, the vehicle number position determination unit 115 determines whether the position of the vehicle number in the

image is within the imaging area of the neighboring camera 130 with reference to information regarding the camera ID and the information regarding the central position of the vehicle number detection region. For example, the vehicle number position determination unit 115 stores the setting of the coordinate region which is the imaging area of the neighboring camera 130 on an orthogonal coordinate system in which the horizontal direction of an image is set as the X axis and the vertical direction of the image is set as the Y axis on the assumption that the top left of the image is a base point. This setting differs for each camera 130 that captures the image. The vehicle number position determination unit 115 specifies the camera 130 capturing the image for which a vehicle number is subjected to the optical character recognition with reference to the information regarding the camera ID. Then, the vehicle number position determination unit 115 determines whether the position of the vehicle number in the image is within the imaging area of the neighboring camera 130 with reference to the foregoing setting corresponding to the specified camera 130 and the coordinates of the information regarding the central position of the vehicle number detection region. As a result, when the vehicle number position determination unit 115 determines that the position of the vehicle number in the image is not within the imaging area of the neighboring camera 130 (S303: No), the vehicle number position determination unit 115 transmits the data ID of the foregoing one of vehicle number data to the vehicle number data integration unit 125.

[0096]

When the vehicle number data integration unit 125 of the vehicle number data processing device 110 receives the data ID transmitted from the vehicle number position determination unit 115, the vehicle number data integration unit 125 sets the foregoing one of vehicle number data identified with the data ID as the integrated vehicle number

data (S307). More specifically, the vehicle number data integration unit 125 rewrites the value of the information regarding whether the integration of the foregoing one of vehicle number data identified with the data ID received from the vehicle number position determination unit 115 is completed (Yes or No) from "No" to "Yes" among the information stored in the vehicle number data storage unit 126.

[0097]

Thus, when the position of the vehicle number detected from the image captured by the camera 130 is out of the imaging area of the neighboring camera 130, the vehicle number data processing device 110 sets the vehicle number data including the information regarding the vehicle number as the integrated vehicle number data.

[0098]

Conversely, when the vehicle number position determination unit 115 determines in step S303 that the position of the vehicle number in the image is within the imaging area of the neighboring camera 130 (S303: Yes), the vehicle number position determination unit 115 transmits the data ID of the foregoing one of vehicle number data to the optical character recognition determination unit 116.

[0099]

When the optical character recognition of the vehicle number data generation device 150 fails, the information regarding the central position of the vehicle number detection region is empty. In this case, the vehicle number position determination unit 115 determines whether the position of the vehicle number in the image is within the imaging area of the neighboring camera 130 with reference to the information regarding the camera ID and the information regarding the central position of the vehicle detection region.

[0100]

When the optical character recognition determination unit 116 of the vehicle number data processing device 110 receives the data ID transmitted from the vehicle number position determination unit 115, the optical character recognition determination unit 116 determines whether a portion unrecognizable through the optical character recognition is contained in the vehicle number indicated by the information included in the foregoing one of vehicle number data identified with the data ID (S304). More specifically, the optical character recognition determination unit 116 reads the information regarding the vehicle number of the foregoing one of vehicle number data identified with the data ID received from the vehicle number position determination unit 115 among the information stored in the vehicle number data storage unit 126. Then, the optical character recognition determination unit 116 determines whether a portion unrecognizable through the optical character recognition is contained in the vehicle number indicated by the information. For example, when "?" is contained in a character string of the vehicle number, the optical character recognition determination unit 116 determines that the portion unrecognizable through the optical character recognition is contained in the vehicle number. As a result, when the optical character recognition determination unit 116 determines that the portion unrecognizable through the optical character recognition is not contained in the vehicle number (S304: No), the optical character recognition determination unit 116 transmits the data ID of the foregoing one of vehicle number data to the same-vehicle-number searching unit 117.

[0101]

When the same-vehicle-number searching unit 117 of the vehicle number data processing device 110 receives the data ID transmitted from the optical character recognition determination unit 116, the same-vehicle-number searching unit 117 searches the vehicle number data including the same information as the information regarding the

vehicle number included in the foregoing one of vehicle number data identified with the data ID (S305). More specifically, the same-vehicle-number searching unit 117 reads the information regarding the camera ID and the information regarding the vehicle number of the foregoing one of vehicle number data identified with the data ID received from the optical character recognition determination unit 116 among the information stored in the vehicle number data storage unit 126. Then, the same-vehicle-number searching unit 117 reads the vehicle number data including the information regarding the camera ID of the camera 130 neighboring the camera 130 identified with the camera ID from the information stored in the vehicle number data storage unit 126. Then, the same-vehicle-number searching unit 117 searches the vehicle number data including the same information as the information regarding the vehicle number included in the foregoing one of vehicle number data among the read vehicle number data. As a result, when there is the vehicle number data including the information regarding the same vehicle number (S306: Yes), the same-vehicle-number searching unit 117 transmits the data ID of the vehicle number data and the data ID of the foregoing one of vehicle number data to the vehicle number data integration unit 125.

[0102]

When the vehicle number data integration unit 125 receives the two data IDs transmitted from the same-vehicle-number searching unit 117, the vehicle number data integration unit 125 integrates the two of vehicle number data identified with the data IDs (S307). More specifically, the vehicle number data integration unit 125 reads information regarding optical character recognition estimation values of the two of vehicle number data identified with the data IDs received from the same-vehicle-number searching unit 117 among the information stored in the vehicle number data storage unit 126. Then, the vehicle number data integration unit 125 compares the magnitudes of

the values of the information regarding the two optical character recognition estimation values with each other. Then, the vehicle number data integration unit 125 deletes the information regarding the smaller optical character recognition estimation value and all of the other information associated with this information from the vehicle number data storage unit 126. Then, the vehicle number data integration unit 125 rewrites the value of the information regarding whether the integration is completed (Yes or No), which is stored in the vehicle number data storage unit 126 in association with the information regarding the larger optical character recognition estimation value, from "No" to "Yes."

[0103]

Thus, when there are the two of vehicle number data obtained by performing the optical character recognition on the images captured by the neighboring cameras 130, the vehicle number data processing device 110 integrates the two of vehicle number data by deleting the vehicle number data of which the degree of reliability of the optical character recognition result is lower and reserving the vehicle number data of which the degree of the reliability of the optical character recognition result is higher.

[0104]

Conversely, when the optical character recognition determination unit 116 determines in step S304 that the portion unrecognizable through the optical character recognition is contained in the vehicle number (S304: Yes), the optical character recognition determination unit 116 transmits the data ID of the foregoing one of vehicle number data to the character complementing unit 118.

[0105]

When the character complementing unit 118 of the vehicle number data processing device 110 receives the data ID transmitted from the optical character recognition determination unit 116, the character complementing unit 118 complements a

character of the portion unrecognizable through the optical character recognition in the character string of the vehicle number included in the vehicle number data identified with the data (S308). More specifically, the character complementing unit 118 reads the information regarding the vehicle number of the vehicle number data identified with the data ID received from the optical character recognition determination unit 116 among the information stored in the vehicle number data storage unit 126. Then, the character complementing unit 118 complements the character of the portion unrecognizable through the optical character recognition in the character string of the vehicle number. For example, the portion unrecognizable through the optical character recognition is supposed to be "?" For example, the character complementing unit 118 complements the portion unrecognized through the optical character recognition and supposed to be "?" using a character which is the most plausible with reference to a database or the like indicating a pattern of the character string of the vehicle number. Then, the character complementing unit 118 rewrites the information regarding the vehicle number stored in the vehicle number data storage unit 126 to the information regarding the vehicle number complemented using the character of the portion unrecognizable through the optical character recognition. Then, the character complementing unit 118 transmits the data ID of the foregoing one of vehicle number data to the same-period-of-time searching unit 119.

[0106]

Conversely, when there is no vehicle number data including the information regarding the same vehicle number in step S306 (S306: Yes), the same-vehicle-number searching unit 117 transmits the data ID of the foregoing one of vehicle number data to the same-period-of-time searching unit 119.

[0107]

When the same-period-of-time searching unit 119 of the vehicle number data processing device 110 receives the data ID transmitted from the character complementing unit 118 or the same-vehicle-number searching unit 117, the same-period-of-time searching unit 119 searches the vehicle number data including the information regarding the initial time or the information regarding the final time corresponding to the period of time from the initial time to the final time included in the foregoing one of vehicle number data identified with the data ID (S309). More specifically, the same-period-of-time searching unit 119 reads the information regarding the initial detection time (year/month/day/hour:minute:second) and the final detection time (year/month/day/hour:minute:second) of the vehicle number data identified by the data ID received from the character complementing unit 118 or the same-vehicle-number searching unit 117 among the information stored in the vehicle number data storage unit 126. Then, the same-period-of-time searching unit 119 calculates a period of time from the time indicated by the information regarding the initial detection time (year/month/day/hour:minute:second) to the time indicated by the information regarding the final detection time (year/month/day/hour:minute:second). Then, the same-period-of-time searching unit 119 searches the vehicle number data including information regarding a time corresponding to the calculated period of time with reference to the information regarding the initial detection times (year/month/day/hour:minute:second) and the information regarding the final detection times (year/month/day/hour:minute:second) of the plurality of vehicle number data stored in the vehicle number data storage unit 126. As a result, when there is one of vehicle number data or more including the information regarding a time corresponding to the period of time (S310: Yes), the same-period-of-time searching unit 119 transmits the data ID of each of vehicle number data and the data ID of the foregoing one of vehicle

number data to the same-vehicle-number searching unit 117.

[0108]

When the same-vehicle-number searching unit 117 receives the data IDs transmitted from the same-period-of-time searching unit 119, the same-vehicle-number searching unit 117 searches the vehicle number data including the same information as the information regarding the vehicle number included in the foregoing one of vehicle number data identified with the data ID (S311). More specifically, the same-vehicle-number searching unit 117 reads the information regarding the vehicle number of the vehicle number data identified by each of data ID received from the same-period-of-time searching unit 119 among the information stored in the vehicle number data storage unit 126. Then, the same-vehicle-number searching unit 117 searches the vehicle number data including the same information as the information regarding the vehicle number of the foregoing one of vehicle number data among the vehicle number data searched by the same-period-of-time searching unit 119. As a result, when there is the vehicle number data including the information regarding the same vehicle number (S312: Yes), the same-vehicle-number searching unit 117 transmits the data ID of the vehicle number data and the data ID of the foregoing one of vehicle number data to the vehicle number data integration unit 125.

[0109]

When the vehicle number data integration unit 125 receives the two data IDs transmitted from the same-vehicle-number searching unit 117, the vehicle number data integration unit 125 integrates the two of vehicle number data identified by the data IDs (S307). More specifically, the vehicle number data integration unit 125 reads the information regarding the optical character recognition estimation values of the two of vehicle number data identified by the data IDs received from the same-vehicle-number

searching unit 117 among the information stored in the vehicle number data storage unit 126. Then, the vehicle number data integration unit 125 compares the magnitudes of the values of the information regarding the two optical character recognition estimation values. Then, the vehicle number data integration unit 125 deletes the information regarding the smaller optical character recognition estimation value and all of the other information associated with this information from the vehicle number data storage unit 126. Then, the vehicle number data integration unit 125 rewrites the value of the information regarding whether the integration is completed (Yes or No), which is stored in the vehicle number data storage unit 126 in association with the information of the larger optical character recognition estimation value, from "No" to "Yes."

[0110]

Thus, when the portion unrecognizable through the optical character recognition is contained in the character string of the vehicle number, the vehicle number data processing device 110 complements the character and then integrates the two of vehicle number data including the information regarding the vehicle present during the same period of time in the imaging regions of the neighboring cameras 130.

[0111]

Conversely, when there is no vehicle number data including the information regarding the same vehicle number in step S312 (S312: No), the same-vehicle-number searching unit 117 transmits the data ID of each of vehicle number data searched by the same-period-of-time searching unit 119 and the data ID of the foregoing one of vehicle number data to the same-kind-of-number-plate searching unit 120.

[0112]

When the same-kind-of-number-plate searching unit 120 of the vehicle number data processing device 110 receives the data IDs transmitted from the

same-vehicle-number searching unit 117, the same-kind-of-number-plate searching unit 120 searches the vehicle number data including the same information as the information regarding the kind of number plate included in the foregoing one of vehicle number data identified with the data ID (S313). More specifically, the same-kind-of-number-plate searching unit 120 reads the information regarding the kind of number plate of the vehicle number data identified with each data ID received from the same-vehicle-number searching unit 117 among the information stored in the vehicle number data storage unit 126. Then, the same-kind-of-number-plate searching unit 120 searches the vehicle number data including the same information as the information regarding the kind of number plate of the foregoing one of vehicle number data among the vehicle number data searched by the same-period-of-time searching unit 119. As a result, when there is only one of vehicle number data including the information regarding the same kind of number plate (S314: Yes → S315: Yes), the same-kind-of-number-plate searching unit 120 transmits the data ID of the vehicle number data and the data ID of the foregoing one of vehicle number data to the vehicle number data integration unit 125.

[0113]

When the vehicle number data integration unit 125 receives the two data IDs transmitted from the same-kind-of-number-plate searching unit 120, the vehicle number data integration unit 125 integrates the two of vehicle number data identified by the data IDs (S307). More specifically, the vehicle number data integration unit 125 reads the information regarding the vehicle number of the two of vehicle number data identified by the data IDs received from the same-kind-of-number-plate searching unit 120 among the information stored in the vehicle number data storage unit 126. At this time, when the information regarding the vehicle number is included only in one of the vehicle number data, the vehicle number data integration unit 125 deletes each piece of information of

the vehicle number data not including the information regarding the vehicle number from the vehicle number data storage unit 126. Then, the vehicle number data integration unit 125 rewrites the value of the information regarding whether the integration of the vehicle number data including the information regarding the vehicle number is completed (Yes or No) from "No" to "Yes." Conversely, when the information regarding the vehicle number is not included in any of the two of vehicle number data, the vehicle number data integration unit 125 reads the information regarding the vehicle detection estimation values of the two of vehicle number data among the information stored in the vehicle number data storage unit 126. Then, the vehicle number data integration unit 125 compares the magnitudes of the values of the information regarding the two vehicle detection estimation values to each other. Then, the vehicle number data integration unit 125 deletes the information regarding the smaller vehicle detection estimation value and all of the other information associated with this information from the vehicle number data storage unit 126. Then, the vehicle number data integration unit 125 rewrites the value of the information regarding whether the integration is completed (Yes or No), which is stored in the vehicle number data storage unit 126 in association with the information regarding the larger vehicle detection estimation value, from "No" to "Yes."

[0114]

Thus, when there is no vehicle number data including the information regarding the same vehicle number, the vehicle number data processing device 110 integrates the two of vehicle number data including the information regarding the same kind of number plate.

[0115]

Conversely, when there are the plurality of vehicle number data including the

information regarding the same kind of number plate in steps S314 and S315 (S314: Yes → S315: No), the same-kind-of-number-plate searching unit 120 transmits the data IDs of the plurality of vehicle number data and the data ID of the foregoing one of vehicle number data to the vehicle speed estimation unit 121, the period-of-time estimation unit 122, and the detection position estimation unit 123.

[0116]

When the vehicle speed estimation unit 121 of the vehicle number data processing device 110 receives the data ID transmitted from the same-kind-of-number-plate searching unit 120, the vehicle speed estimation unit 121 estimates the degree of accordance between a vehicle speed indicated by the information included in the foregoing one of vehicle number data and a vehicle speed indicated by the information included in each of the plurality of vehicle number data searched by the same-kind-of-number-plate searching unit 120 (S316). More specifically, the vehicle speed estimation unit 121 reads the information regarding a vehicle speed (km/h) of the vehicle number data identified by each data ID received from the same-kind-of-number-plate searching unit 120 among the information stored in the vehicle number data storage unit 126. Then, the vehicle speed estimation unit 121 estimates the degree of accordance between the value of the information regarding the vehicle speed (km/h) of the foregoing one of vehicle number data and the value of the information regarding the vehicle speed (km/h) of each of the plurality of vehicle number data searched by the same-kind-of-number-plate searching unit 120. For example, the vehicle speed estimation unit 121 estimates, as the degree of accordance between the vehicle speeds, an overlapping amount of two normal distributions when the normal distributions for measurement values of the vehicle speeds are assumed using the values of the information regarding the vehicle speeds (km/h) as median values. Then, the

vehicle speed estimation unit 121 transmits the data ID of the foregoing one of vehicle number data, the data IDs of the plurality of vehicle number data searched by the same-kind-of-number-plate searching unit 120, and the estimation result of the degree of accordance between the vehicle speeds to the vehicle number data integration unit 125.

[0117]

When the period-of-time estimation unit 122 of the vehicle number data processing device 110 receives the data IDs transmitted from the same-kind-of-number-plate searching unit 120, the period-of-time estimation unit 122 estimates the degree of accordance between the period of time from the initial detection time to the final detection time of the vehicle indicated by the information included in the foregoing one of vehicle number data and the period of time from the initial detection time to the final detection time of the vehicle indicated by the information included in each of the plurality of vehicle number data searched by the same-kind-of-number-plate searching unit 120 (S317). More specifically, the period-of-time estimation unit 122 reads each piece of information regarding the initial detection time (year/month/day/hour:minute:second) and the final detection time (year/month/day/hour:minute:second) of the vehicle number data identified by each data ID received from the same-kind-of-number-plate searching unit 120 among the information stored in the vehicle number data storage unit 126. Then, the period-of-time estimation unit 122 estimates the degree of accordance between the period of time from the time of the information regarding the initial detection time (year/month/day/hour:minute:second) to the time of the information regarding the final detection time (year/month/day/hour:minute:second) of the foregoing one of vehicle number data and the period of time from the time of the information regarding the initial detection time (year/month/day/hour:minute:second) to the time of the information

regarding the final detection time (year/month/day/hour:minute:second) of each of the plurality of vehicle number data searched by the same-kind-of-number-plate searching unit 120.

Then, the period-of-time estimation unit 122 transmits the data ID of the foregoing one of vehicle number data, the data IDs of the plurality of vehicle number data searched by the same-kind-of-number-plate searching unit 120, and the estimation result of the degree of accordance between the periods of time to the vehicle number data integration unit 125.

[0118]

When the detection position estimation unit 123 of the vehicle number data processing device 110 receives the data IDs transmitted from the same-kind-of-number-plate searching unit 120, the detection position estimation unit 123 estimates the degree of accordance between the detection position of the vehicle indicated by the information included in the foregoing one of vehicle number data and the detection position of the vehicle indicated by the information included in each of the plurality of vehicle number data searched by the same-kind-of-number-plate searching unit 120 (S318). More specifically, the detection position estimation unit 123 reads the information regarding the camera ID, the number of vehicles (vehicles), and the detection position (vehicle sequence) identified by each data ID received from the same-kind-of-number-plate searching unit 120 among the information stored in the vehicle number data storage unit 126. Then, referring to the information, the detection position estimation unit 123 estimates the degree of accordance between the detection position of the vehicle indicated by the information included in the foregoing one of vehicle number data and the detection position of the vehicle indicated by the information included in each of the plurality of vehicle number data searched by the

same-kind-of-number-plate searching unit 120. For example, a vehicle indicated by the information included in one of vehicle number data is assumed to be imaged by the camera 130a. Further, the camera 130a is assumed to detect a sum of two vehicles including this vehicle during a period of time at which this vehicle is detected. Furthermore, the camera 130a is assumed to detect this vehicle at the position of the second vehicle from the left side between the two vehicles when viewed in the movement direction. In this case, the detection position estimation unit 123 estimates that the detection position of the vehicle detected at the position of the first vehicle from the left side by the camera 130b has the highest degree of accordance with the detection position of the vehicle indicated by the information included in the one of vehicle number data. Then, the detection position estimation unit 123 transmits the data ID of the foregoing one of vehicle number data, the data IDs of the plurality of vehicle number data searched by the same-kind-of-number-plate searching unit 120, and the estimation result of the degree of accordance between the detection positions to the vehicle number data integration unit 125.

[0119]

When the vehicle number data integration unit 125 receives the data IDs and the estimation results transmitted from the vehicle speed estimation unit 121, the period-of-time estimation unit 122, and the detection position estimation unit 123, the vehicle number data integration unit 125 integrates the foregoing one of vehicle number data and the vehicle number data with the highest estimation result obtained by the vehicle speed estimation unit 121, the period-of-time estimation unit 122, and the detection position estimation unit 123 (S307). More specifically, the vehicle number data integration unit 125 specifies the vehicle number data with the comprehensively highest estimation result transmitted from the period-of-time estimation unit 122 and the

detection position estimation unit 123. Then, the vehicle number data integration unit 125 integrates this vehicle number data and the foregoing one of vehicle number data. At this time, when the information regarding the vehicle number is included only in one of the vehicle number data, the vehicle number data integration unit 125 deletes each piece of information of the vehicle number data not including the information regarding the vehicle number from the vehicle number data storage unit 126. Then, the vehicle number data integration unit 125 rewrites the value of the information regarding whether the integration of the vehicle number data including the information regarding the vehicle number is completed (Yes or No) from "No" to "Yes." Conversely, when the information regarding the vehicle number is not included in any of the two of vehicle number data, the vehicle number data integration unit 125 reads the information regarding the vehicle detection estimation values of the two of vehicle number data among the information stored in the vehicle number data storage unit 126. Then, the vehicle number data integration unit 125 compares the magnitudes of the values of the information regarding the two vehicle detection estimation values to each other. Then, the vehicle number data integration unit 125 deletes the information regarding the smaller vehicle detection estimation value and all of the other information associated with this information from the vehicle number data storage unit 126. Then, the vehicle number data integration unit 125 rewrites the value of the information regarding whether the integration is completed (Yes or No), which is stored in the vehicle number data storage unit 126 in association with the information regarding the larger vehicle detection estimation value, from "No" to "Yes."

[0120]

Thus, when there is no vehicle number data including the information regarding the same vehicle number, the vehicle number data processing device 110 estimates the

speed of a vehicle which is a target of the information included in the foregoing one of vehicle number data, the period of time at which the vehicle is detected, and the position at which the vehicle is detected and integrates the foregoing one of vehicle number data and the vehicle number data which is the most plausible among the plurality of vehicle number data including the information regarding the same kind of number plate.

[0121]

Conversely, when there is no vehicle number data in step S310 (S310: No), the same-period-of-time searching unit 119 transmits the data ID of the foregoing one of vehicle number data to the imaging time determination unit 124. Likewise, when there is no vehicle number data in step S314 (S314: No), the same-kind-of-number-plate searching unit 120 transmits the data ID of the foregoing one of vehicle number data to the imaging time determination unit 124.

[0122]

When the imaging time determination unit 124 of the vehicle number data processing device 110 receives the data ID transmitted from the same-period-of-time searching unit 119 or the same-kind-of-number-plate searching unit 120, the imaging time determination unit 124 determines whether an imaging time of an image which is being subjected to the optical character recognition by each vehicle number data generation device 150 is a time earlier than the time indicated by the information regarding the final detection time of the vehicle included in the vehicle number data identified with this data ID (S319). More specifically, the imaging time determination unit 124 reads the information regarding the final detection time (year/month/day/hour:minute:second) of the vehicle number data identified with the data ID received from the same-period-of-time searching unit 119 or the same-kind-of-number-plate searching unit 120 among the information stored in the

vehicle number data storage unit 126. Then, the imaging time determination unit 124 compares the final detection time of the vehicle indicated by this information with the imaging time of the image which is indicated by the data finally received from the check data reception unit 111 and is being subjected to the optical character recognition. As a result, when the imaging time of the image which is being subjected to the optical character recognition is the time earlier than the final detection time of the vehicle (S319: Yes), the imaging time determination unit 124 waits until a subsequent process.

[0123]

Thus, when there is no vehicle number data including the information which can be integrated with the foregoing one of vehicle number data and there is the image which is captured at the time earlier than the final detection time of the vehicle indicated by the information included in the one of vehicle number data and is being subjected to the optical character recognition, the vehicle number data processing device 110 does not perform the process of integrating the foregoing one of vehicle number data.

[0124]

Conversely, when the imaging time of the image which is being subjected to the optical character recognition is a time later than the final detection time of the vehicle in step S319 (S310: No), the imaging time determination unit 124 transmits the data ID of the foregoing one of vehicle number data to the vehicle number data integration unit 125.

[0125]

When the vehicle number data integration unit 125 receives the data ID transmitted from the imaging time determination unit 124, the vehicle number data integration unit 125 sets the vehicle number data identified by this data ID as the integrated vehicle number data (S307). More specifically, the vehicle number data integration unit 125 rewrites the value of the information regarding whether the

integration is completed (Yes or No), which is stored in association with the data received from the imaging time determination unit 124 among the information stored in the vehicle number data storage unit 126, from "No" to "Yes."

[0126]

Thus, when there is no vehicle number data including the information which can be integrated with the foregoing one of vehicle number data and there is no image which is captured at a time earlier than the final detection time of the vehicle indicated by the information included in the one of vehicle number data and is being subjected to the optical character recognition, the vehicle number data processing device 110 sets the one of vehicle number data as the integrated vehicle number data.

[0127]

As described above, the plurality of cameras 130 are installed to be lined up in the width direction above the road R10 so that the neighboring imaging areas overlap and continuously image the road while facing obliquely downward. Then, the vehicle number data processing device 110 integrates the vehicle number data including the information regarding the predetermined vehicle by reserving one of vehicle number data along with deleting the other of vehicle number data between the vehicle number data including the information regarding the vehicle number obtained by performing the optical character recognition on an image captured by one camera 130 and the vehicle number data including the information regarding the vehicle number obtained by performing the optical character recognition on the image captured by the camera 130 neighboring the one camera 130. Thus, in the vehicle number data processing system 100, of the plurality of data indicating the vehicle numbers of the number plates obtained by performing the optical character recognition on the images captured by the cameras 130, the data indicating the vehicle number of the predetermined vehicle can be

processed as one of data.

[0128]

As described above, the vehicle number data processing device 110 searches the vehicle number data including the same information as information regarding the vehicle number included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130, among the vehicle number data obtained by performing the optical character recognition on images captured by the camera 130 neighboring the one camera 130. Then, the vehicle number data processing device 110 integrates the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 and the searched vehicle number data including the information regarding the same vehicle number. Thus, in the vehicle number data processing system 100, when there is the vehicle number data including the information regarding the same vehicle number, this vehicle number data can be integrated.

[0129]

As described above, the vehicle number data processing device 110 determines whether the portion unrecognizable through the optical character recognition is contained in the vehicle number obtained by performing the optical character recognition on an image captured by one camera 130. Then, when the portion unrecognizable through the optical character recognition is not contained in the vehicle number, the vehicle number data processing device 110 searches the vehicle number data including the same information as the information regarding the vehicle number. Thus, in the vehicle number data processing system 100, the vehicle number data including the information regarding the same vehicle number can be searched using the information regarding the vehicle number in which the portion unrecognizable through the optical character

recognition is not contained.

[0130]

As described above, the vehicle number data processing device 110 determines whether the position of the vehicle number obtained by performing the optical character recognition on an image captured by one camera 130 in the image is within the imaging area of the camera 130 neighboring the one camera 130. Then, when the position of the vehicle number in the image is within the imaging area of the camera 130 neighboring the one camera 130, the vehicle number data processing device 110 determines whether a portion unrecognizable through the optical character recognition is contained in the vehicle number. Thus, in the vehicle number data processing system 100, when the vehicle is imaged in the imaging region overlapping the imaging region of the neighboring camera 130, the vehicle number data obtained by performing the optical character recognition on the image can be processed as the data to be integrated with the other vehicle number data.

[0131]

As described above, the vehicle number data processing device 110 determines whether the vehicle number data is the integrated vehicle number data. Then, when the vehicle number data is not the integrated vehicle number data, the vehicle number data processing device 110 determines whether the position of the vehicle number included in the vehicle number data in the image is within the imaging area of the neighboring imaging device. Thus, in the vehicle number data processing system 100, only the vehicle number data which is not integrated can be processed as the data to be integrated.

[0132]

As described above, the vehicle number data generation devices 150 are installed in the one-to-one correspondence with the cameras 130, perform the optical

character recognition on the images captured by the corresponding cameras 130, and generate the vehicle number data. Then, the vehicle number data processing device 110 receives the check data from the vehicle number data generation devices 150. The vehicle number data processing device 110 also receives the vehicle number data from the vehicle number data generation devices 150. Then, the vehicle number data processing device 110 receives the vehicle number data, and then determines whether to receive the check data. Then, when the vehicle number data processing device 110 receives the vehicle number data and then receives the check data, the vehicle number data processing device 110 determines whether the vehicle number data is the integrated vehicle number data. Thus, in the vehicle number data processing system 100, for example, when reception times of two of vehicle number data regarding the predetermined vehicle deviate from each other due to deviation between times taken to perform the optical character recognition or an influence of communication delay or the like and only one of vehicle number data is received, the vehicle number data can be set to be a target of the integration process as little as possible.

[0133]

As described above, when the vehicle number data generation device 150 performs the optical character recognition on the image captured by the corresponding camera 130 and generates the vehicle number data including the information regarding the vehicle number of the number plate of the vehicle, the vehicle number data generation device 150 generates the vehicle number data further including the information regarding the initial time and the information regarding the final time at which the vehicle is detected by the corresponding camera 130. When a portion unrecognizable through the optical character recognition is contained in the vehicle number, the vehicle number data processing device 110 complements a character of the

vehicle number of the portion unrecognizable through the optical character recognition. When the portion unrecognizable through the optical character recognition is contained in the vehicle number or the vehicle number data including the information regarding the same vehicle number may not be searched, the vehicle number data processing device 110 searches the vehicle number data including the information regarding the initial time or the information regarding the final time corresponding to the period of time from the initial time to the final time included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130, among the vehicle number data obtained by performing the optical character recognition on images captured by the camera 130 neighboring the one camera 130. Then, the vehicle number data processing device 110 searches the vehicle number data including the same information as the information regarding the vehicle number of which the character is complemented, among the searched vehicle number data including the information regarding the initial time or the information regarding the final time corresponding to the foregoing period of time. Thus, in the vehicle number data processing system 100, even when there is the vehicle number containing the portion unrecognizable through the optical character recognition, the character of the portion unrecognizable through the optical character recognition can be complemented and the process of integrating the vehicle number data can be performed.

[0134]

As described above, when the vehicle number data generation device 150 performs the optical character recognition on the image captured by the corresponding camera 130 and generates the vehicle number data including the information regarding the vehicle number of the number plate of a vehicle, the vehicle number data generation device 150 generates the vehicle number data further including the information regarding

the kind of number plate of the vehicle. Then, when the vehicle number data processing device 110 may not search the vehicle number data including the information regarding the same vehicle number among the searched vehicle number data, the vehicle number data processing device 110 searches the vehicle number data including the same information as the information regarding the kind of number plate included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130, among the vehicle number data obtained by performing the optical character recognition on images captured by the camera 130 neighboring the one camera 130. Then, when the vehicle number data generation device 150 searches one of vehicle number data, the vehicle number data generation device 150 integrates the vehicle number data and the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130. Thus, in the vehicle number data processing system 100, even when the vehicle number data to which the information regarding the vehicle number corresponds may not be searched, two of vehicle number data including the information regarding the same kind of number plate can be integrated.

[0135]

As described above, when the vehicle number data generation device 150 searches the plurality of vehicle number data including the information regarding the same kind of number plate, the vehicle number data generation device 150 estimates the degree of accordance between the vehicle speed indicated by the information included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 and the vehicle speed indicated by the information included in the vehicle number data obtained by performing the optical character recognition on an image captured by the camera 130 neighboring the one camera 130.

Then, the vehicle number data generation device 150 integrates the vehicle number data including the information regarding the vehicle speeds of which the estimated degree of accordance is high. Thus, in the vehicle number data processing system 100, even when the vehicle number data to which the information regarding the vehicle number or the information regarding the kind of number plate corresponds may not be searched, the vehicle number data of which the degree of accordance between the information regarding the vehicle speeds of the vehicle captured by the cameras 130 is high can be integrated.

[0136]

As described above, when the vehicle number data processing device 110 searches the plurality of vehicle number data including the information regarding the same kind of number plate, the vehicle number data processing device 110 estimates the degree of accordance between the period of time from the initial detection time to the final detection time of the vehicle indicated by the information included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 and the period of time from the initial detection time to the final detection time of the vehicle indicated by the information included in the vehicle number data obtained by performing the optical character recognition on an image captured by the camera 130 neighboring the one camera 130. Then, the vehicle number data processing device 110 integrates the vehicle number data including the information regarding the times of which the estimated degree of accordance is high. Thus, in the vehicle number data processing system 100, even when the vehicle number data to which the information regarding the vehicle number or the information regarding the kind of number plate corresponds may not be searched, the vehicle number data of which the degree of accordance between the periods of time from the time indicated by the

information regarding the initial detection time of the vehicle imaged by the camera 130 to the time indicated by the information regarding the final detection time of the vehicle is high can be integrated.

[0137]

As described above, when the vehicle number data generation device 150 performs the optical character recognition on the image captured by the corresponding camera 130 and generates the vehicle number data including the information regarding the vehicle number of the number plate of the vehicle, the vehicle number data generation device 150 generates the vehicle number data further including the information regarding the detection position of the vehicle with respect to the detection positions of all of the vehicles detected during the period of time in which the vehicle is detected by the corresponding camera 130. Then, when the vehicle number data processing device 110 searches the plurality of vehicle number data including the information regarding the same kind of number plate, the vehicle number data processing device 110 estimates the degree of accordance between the detection position of the vehicle indicated by the information included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 and the detection position of the vehicle indicated by the information included in the vehicle number data obtained by performing the optical character recognition on an image captured by the camera 130 neighboring the one camera 130. Then, the vehicle number data processing device 110 integrates the vehicle number data including the information regarding the detection positions of which the estimated degree of accordance is high. Thus, in the vehicle number data processing system 100, even when the vehicle number data to which the information regarding the kind of number plate corresponds may not be searched, the vehicle number data of which the degree of

accordance between the information regarding the detection positions of the vehicle captured by the cameras 130 is high can be integrated.

[0138]

As described above, when the vehicle number data processing device 110 may not search the vehicle number data including the information regarding the detection time of the vehicle during the same period of time or the vehicle number data including the information regarding the same kind of number plate, the vehicle number data processing device 110 determines whether the imaging time of the image which is being subjected to the optical character recognition by the vehicle number data generation device 150 is a time earlier than the final time at which the vehicle is detected and which is included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130. Then, when the imaging time is not the time earlier than the final time, the vehicle number data processing device 110 sets the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 as the integrated vehicle number data. Thus, in the vehicle number data processing system 100, when the image captured earlier than the final detection time of the vehicle indicated by the information included in one of vehicle number data is being subjected to the optical character recognition, the vehicle number data obtained by performing the optical character recognition on the image can be set as the data which is plausible to be integrated with the foregoing one of vehicle number data and the process of integrating the foregoing one of vehicle number data can be postponed.

[0139]

FIG. 13 illustrates an example of a hardware configuration of a computer 800 configured as the vehicle number data processing device 110 according to the

embodiment. The computer 800 according to the embodiment includes a central processing unit (CPU) peripheral unit including a CPU 802, a random access memory (RAM) 803, a graphic controller 804, and a display 805 mutually connected by a host controller 801, an input/output unit including a communication interface 807, a hard disk drive 808, and a compact disk read-only memory (CD-ROM) drive 809 mutually connected by an input/output controller 806, and a legacy input/output unit including a read-only memory (ROM) 810, a flexible disk drive 811, and an input/output chip 812 connected to the input/output controller 806.

[0140]

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

[0141]

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

[0142]

The ROM 810, and the flexible disk drive 811 and the input/output chip 812,

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

[0143]

A program supplied to the hard disk drive 808 via the RAM 803 is stored in a recording medium such as the flexible disk 893, the CD-ROM 892, or an integrated circuit (IC) card to be supplied to a user. The program is read from the recording medium, is installed on the hard disk drive 808 in the computer 800 via the RAM 803, and is executed by the CPU 802.

[0144]

A program installed on the computer 800 and causing the computer 800 to function as the vehicle number data processing device 110 causes the computer 800 to function as the vehicle number data integration unit 125 that integrates the vehicle number data including the information regarding the predetermined vehicle by reserving one of vehicle number data along with deleting the other of the vehicle number data between the vehicle number data including the information regarding the vehicle number obtained by performing the optical character recognition on an image captured by one camera 130 and the vehicle number data including the information regarding the vehicle number obtained by performing the optical character recognition on an image captured by the camera 130 neighboring the one camera 130 in step S307.

[0145]

The program may cause the computer 800 to function as the same-vehicle-number searching unit 117 that searches the vehicle number data including the same information as the information regarding the vehicle number included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 among the vehicle number data obtained by performing the optical character recognition on images captured by the camera 130 neighboring the one camera 130 in step S306 and to function as the vehicle number data integration unit 125 that integrates the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 and the vehicle number data searched by the same-vehicle-number searching unit 117 in step S307.

[0146]

The program may cause the computer 800 to function as the optical character recognition determination unit 116 that determines in step S304 whether a portion unrecognizable through the optical character recognition is contained in the vehicle number obtained by performing the optical character recognition on an image captured by one camera 130 and to function as the same-vehicle-number searching unit 117 that searches the vehicle number data including the same information as the information regarding the vehicle number in step S305 when the optical character recognition determination unit 116 determines that the portion unrecognizable through the optical character recognition is not contained in the vehicle number.

[0147]

The program may cause the computer 800 to function as the vehicle number position determination unit 115 that determines in step S303 whether the position of the vehicle number obtained by performing the optical character recognition on an image

captured by one camera 130 in the image is within the imaging area of the camera 130 neighboring the one camera 130 and to function as the optical character recognition determination unit 116 that determines in step S304 whether a portion unrecognizable through the optical character recognition is contained in the vehicle number when the vehicle number position determination unit 115 determines that the position of the vehicle number is within the imaging area of the camera 130 neighboring the one camera 130.

[0148]

The program may cause the computer 800 to function as the integrated data determination unit 114 that determines in step S302 whether the vehicle number data is the vehicle number data integrated by the vehicle number data integration unit 125 and to function as the vehicle number position determination unit 115 that determines in step S303 whether the position of the vehicle number included in the vehicle number data in the image is within the imaging area of the neighboring camera 130 when the integrated data determination unit 114 determines that the vehicle number data is not the integrated vehicle number data.

[0149]

The program may cause the computer 800 to function as the check data reception unit 111 that receives the check data from the vehicle number data generation device 150 in step S101, to function as the vehicle number data reception unit 112 that receives the vehicle number data from the vehicle number data generation device 150 in step S204, to function as the reception or non-reception determination unit 113 that determines in step S301 whether the check data reception unit 111 receives the check data after the vehicle number data reception unit 112 receives the vehicle number data, and to function as the integrated data determination unit 114 that determines in step S302

whether the vehicle number data is the integrated vehicle number data when the reception or non-reception determination unit 113 determines that the check data reception unit 111 receives the check data after the vehicle number data reception unit 112 receives the vehicle number data.

[0150]

The program may cause the computer 800 to function as the character complementing unit 118 that complements the character of the vehicle number of the portion unrecognizable through the optical character recognition in step S308 when the optical character recognition determination unit 116 determines that the portion unrecognizable through the optical character recognition is contained in the vehicle number, to function as the same-period-of-time searching unit 119 that searches the vehicle number data including the information regarding the initial time or the information regarding the final time corresponding to the period of time from the initial time to the final time included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130, among the vehicle number data obtained by performing the optical character recognition on images captured by the camera 130 neighboring the one camera 130 in step S309 when the optical character recognition determination unit 116 determines that the portion unrecognizable through the optical character recognition is contained in the vehicle number or the same-vehicle-number searching unit 117 may not search the vehicle number data including the information regarding the same vehicle number, and to function as the same-vehicle-number searching unit 117 that searches the vehicle number data including the same information as the information regarding the vehicle number in which the character is complemented by the character complementing unit 118 among the vehicle number data searched by the same-period-of-time searching unit 119 in step

S311.

[0151]

The program may cause the computer 800 to function as the same-kind-of-number-plate searching unit 120 that searches the vehicle number data including the same information as the information regarding the kind of number plate included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 among the vehicle number data obtained by performing the optical character recognition on images captured by the camera 130 neighboring the one camera 130 in step S313 when the same-vehicle-number searching unit 117 may not search the vehicle number data including the information regarding the same vehicle number among the vehicle number data searched by the same-period-of-time searching unit 119 and to function as the vehicle number data integration unit 125 that integrates one of vehicle number data and the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 in step S307 when the same-kind-of-number-plate searching unit 120 searches the one of vehicle number data.

[0152]

The program may cause the computer 800 to function as the vehicle speed estimation unit 121 that estimates the degree of accordance between the vehicle speed indicated by the information included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 and the vehicle speed indicated by the information included in the vehicle number data obtained by performing the optical character recognition on an image captured by the camera 130 neighboring the one camera 130 in step S316 when the same-kind-of-number-plate searching unit 120 searches the plurality of vehicle number data and to function as the

vehicle number data integration unit 125 that integrates the vehicle number data including the information regarding the vehicle speeds of which the degree of accordance estimated by the vehicle speed estimation unit 121 is high in step S307.

[0153]

The program may cause the computer 800 to function as the period-of-time estimation unit 122 that estimates the degree of accordance between the period of time from the initial time to the final time indicated by the information included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 and the period of time from the initial time to the final time indicated by the information included in the vehicle number data obtained by performing the optical character recognition on an image captured by the camera 130 neighboring the one camera 130 in step S317 when the same-kind-of-number-plate searching unit 120 searches the plurality of vehicle number data and to function as the vehicle number data integration unit 125 that integrates the vehicle number data including the information regarding the time of which the degree of accordance estimated by the period-of-time estimation unit 122 is high in step S307.

[0154]

The program may cause the computer 800 to function as the detection position estimation unit 123 that estimates the degree of accordance between the detection position indicated by the information included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 and the detection position indicated by the information included in the vehicle number data obtained by performing the optical character recognition on an image captured by the camera 130 neighboring the one camera 130 in step S318 when the same-kind-of-number-plate searching unit 120 searches the plurality of vehicle number

data and to function as the vehicle number data integration unit 125 that integrates the vehicle number data including the information regarding the detection positions of which the degree of accordance estimated by the detection position estimation unit 123 is high in step S307.

[0155]

The program may cause the computer 800 to function as the imaging time determination unit 124 that determines in step S319 whether the imaging time of the image on which the optical character recognition is being performed by the vehicle number data generation device 150 is a time prior to the final time at which the vehicle included in the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 is detected when the same-period-of-time searching unit 119 or the same-kind-of-number-plate searching unit 120 may not search the vehicle number data and to function as the vehicle number data integration unit 125 that sets the vehicle number data obtained by performing the optical character recognition on an image captured by one camera 130 as the integrated vehicle number data in step S307 when the imaging time determination unit 124 determines that the imaging time is not the time prior to the final time.

[0156]

Information processing described in the program is read by the computer 800 to function as the vehicle number data reception unit 112, the check data reception unit 111, the reception or non-reception determination unit 113, the integrated data determination unit 114, the vehicle number position determination unit 115, the optical character recognition determination unit 116, the same-vehicle-number searching unit 117, the same-period-of-time searching unit 119, the character complementing unit 118, the same-kind-of-number-plate searching unit 120, the vehicle speed estimation unit 121, the

period-of-time estimation unit 122, the detection position estimation unit 123, the imaging time determination unit 124, the vehicle number data integration unit 125, and the vehicle number data storage unit 126 which are specific means that cooperate through software and the above-described various kinds of hardware resources. Calculation or processing of information according to the use purpose of the computer 800 in the embodiment is realized by the specific means so that the distinctive vehicle number data processing device 110 according to the use purpose is constructed.

[0157]

For example, when the computer 800 communicates with an external device or the like, the CPU 802 executes a communication program loaded on the RAM 803 and instructs the communication interface 807 to perform a communication process based on processing content described in the communication program. Under the control of the CPU 802, the communication interface 807 reads transmission data stored in a transmission buffer region or the like provided on a storage device such as the RAM 803, the hard disk drive 808, the flexible disk 893, or the CD-ROM 892 to transmit the transmission data to a network or writes reception data received from a network on a reception buffer region or the like provided on the storage device. Thus, the communication interface 807 may transmit transmission or reception data to a storage device in a direct memory access manner or may instead transmit transmission or reception data in such a manner that the CPU 802 reads data from a storage device or the communication interface 807 of a transmission source and writes the data on a storage device or the communication interface 807 of a transmission destination.

[0158]

The CPU 802 performs various processes on data on the RAM 803 by reading all or necessary portions of the files, databases, or the like stored in an external storage

device such as the hard disk drive 808, the CD-ROM 892, or the flexible disk 893 to the RAM 803 by direct memory access transmission or the like. Then, the CPU 802 writes back processed data on the external storage device by the direct memory access transmission or the like.

[0159]

Since the RAM 803 is considered to temporarily retain content of the external storage device in the process, the RAM 803, the external storage device, and the like are generally referred to as a memory, a storage unit, a storage device, or the like in the embodiment. In the embodiment, various kinds of information such as various programs, data, tables, and databases are stored on the storage device and are information-processing targets. The CPU 802 can retain a part of the RAM 803 in a cache memory and perform reading and writing on the cache memory. Even in this form, the cache memory serves some of the functions of the RAM 803. Therefore, in the embodiment, the cache memory is assumed also to be included in the RAM 803, the memory, and/or the storage device unless distinguished and indicated otherwise.

[0160]

The CPU 802 performs various processes designated by a command string of the program and including various calculations, processing on information, condition determination, information search, and substitution described in the embodiment on data read from the RAM 803 and writes back the data to the RAM 803. For example, when condition determination is performed, the CPU 802 compares various variables indicated in the embodiment with other variables or constants, determines whether conditions such as "greater than," "less than," "equal to or greater than," "equal to or less than," and "equal to" are satisfied, and performs branching to another command string or calls a subroutine when the conditions are satisfied or not satisfied.

[0161]

The CPU 802 can search information stored in files or databases, or the like in a storage device. For example, when a plurality of entries in which an attribute value of a first attribute is associated with an attribute value of a second attribute are stored in a storage device, the CPU 802 can obtain the attribute value of the second attribute associated with the first attribute satisfying a predetermined condition by searching an entry to which the attribute value of the first attribute corresponds with a designated condition among the plurality of entries stored in the storage device and reading the attribute value of the second attribute stored in the entry.

[0162]

The above-described program or module may be stored in an external storage medium. As the storage medium, an optical recording medium such as a digital versatile disk (DVD) or a compact disk (CD), a magneto-optical recording medium such as a magneto-optical disk (MO), a tape medium, or a semiconductor memory such as an IC card can be used in addition to the flexible disk 893 and the CD-ROM 892. A storage medium such as a hard disk or a RAM provided in a server system connected to a dedicated communication network or the Internet may be used as the recording medium and the program may be supplied to the computer 800 via the network.

[0163]

The embodiments of the present invention have been described but the technical scope of the present invention is not limited to the foregoing embodiments. It should be apparent to those skilled in the art that the foregoing embodiments can be modified or improved in various ways. It is apparent from the description of the claims that the modified or improved embodiments are included in the technical scope of the present invention.

[0164]

It should be noted that orders in which processes of operations, procedures, steps, and stages are executed in the systems, the methods, the devices, the programs, and the recording media described in the claims, the present specification, and the drawings can be realized in any order unless expressions such as "earlier than" and "prior to" are particularly clarified or the output of a previous process is used in a subsequent process. Even when operation flows in the claims, the present specification, and the drawings are described using expressions such as "first" and "next" for convenience, the operation flows are not necessarily performed in this order.

Industrial Applicability

[0165]

According to any aspect of the present invention, it is possible to process vehicle number data including information regarding vehicle numbers of number plates of vehicles obtained by performing optical character recognition on images.

Reference Signs List

[0166]

100	Vehicle number data processing system
110	Vehicle number data processing device
111	Check data reception unit
112	Vehicle number data reception unit
113	Reception or non-reception determination unit
114	Integrated data determination unit
115	Vehicle number position determination unit

116 Optical character recognition determination unit

117 Same-vehicle-number searching unit

118 Character complementing unit

119 Same-period-of-time searching unit

120 Same-kind-of-number-plate searching unit

121 Vehicle speed estimation unit

122 Period-of-time estimation unit

123 Detection position estimation unit

124 Imaging time determination unit

125 Vehicle number data integration unit

126 Vehicle number data storage unit

130 Camera

150 Vehicle number data generation device

800 Computer

801 Host controller

802 CPU

803 RAM

804 Graphic controller

805 Display

806 Input/output controller

807 Communication interface

808 Hard disk drive

809 CD-ROM drive

810 ROM

811 Flexible disk drive

812	Input/output chip
891	Network communication device
892	CD-ROM
893	Flexible disk
Aa	Imaging area of camera 130a
Ab	Imaging area of camera 130b
Ac	Imaging area of camera 130c
Ad	Imaging area of camera 130d
G	Gate
R10	Road
R11	Lane
R12	Lane
R13	Lane

Claims

1. A vehicle number data processing system that processes vehicle number data including information regarding a vehicle number of a number plate of a vehicle obtained by performing optical character recognition on an image, the vehicle number data processing system comprising:

a plurality of imaging devices which are installed so that imaging areas of the plurality of imaging devices overlap each other and which are configured to continuously capture an image of a road; and

a vehicle number data processing device configured to process the vehicle number data, wherein the vehicle number data processing device includes:

a vehicle number data integration unit configured to reserve one of one piece of vehicle number data and another piece of vehicle number data along with deleting the other of the one piece of vehicle number data and the another piece of vehicle number data to thereby integrate the vehicle number data including information regarding the same vehicle, wherein the one piece of vehicle number data include information regarding a vehicle number obtained by performing the optical character recognition on an image captured by one of the imaging devices, and the another piece of vehicle number data include information regarding a vehicle number obtained by performing the optical character recognition on an image captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices;

a same-vehicle-number searching unit configured to retrieve vehicle number data including the same information as information regarding the vehicle number included in vehicle number data obtained by performing the optical character recognition on the image captured by the one of the imaging devices, among vehicle number data obtained by performing the optical character recognition on the images captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices;

an optical character recognition determination unit configured to determine whether a portion unrecognizable through the optical character recognition is contained in a vehicle number obtained by performing the optical character recognition on the image captured by the one of the imaging devices;

a vehicle number position determination unit configured to determine whether a position of a vehicle number obtained by performing the optical character recognition on the

image captured by the one of the imaging devices in the image is within the imaging area of another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices; and

an integrated data determination unit configured to determine whether the vehicle number data is the vehicle number data integrated by the vehicle number data integration unit,

wherein the vehicle number data integration unit integrates (i) vehicle number data obtained by performing the optical character recognition on the image captured by the one of the imaging devices and (ii) the vehicle number data retrieved by the same-vehicle-number searching unit,

the same-vehicle-number searching unit retrieves vehicle number data including the same information as information regarding the vehicle number if the optical character recognition determination unit determines that a portion unrecognizable through the optical character recognition is not contained in the vehicle number,

the optical character recognition determination unit determines whether a portion unrecognizable through the optical character recognition is contained in the vehicle number if the vehicle number position determination unit determines that the position of the vehicle number is within the imaging area of another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices, and

the vehicle number position determination unit determines whether a position of a vehicle number included in the vehicle number data in the image is within the imaging area of another of the imaging devices if the integrated data determination unit determines that the vehicle number data is not the integrated vehicle number data.

2. The vehicle number data processing system according to Claim 1, further comprising:

a plurality of vehicle number data generation devices installed in one-to-one correspondence with the imaging devices and configured to generate the vehicle number data by performing the optical character recognition on images captured by the corresponding imaging devices,

wherein the vehicle number data processing device further includes:

a check data reception unit configured to receive check data used to check soundness of a network from the vehicle number data generation devices;

a vehicle number data reception unit configured to receive the vehicle number

data from the vehicle number data generation devices; and

a reception or non-reception determination unit configured to determine, after the vehicle number data reception unit receives the vehicle number data, whether the check data reception unit receives the check data, and

wherein, if the reception or non-reception determination unit determines that the check data reception unit receives the check data after the vehicle number data reception unit receives the vehicle number data, the integrated data determination unit determines whether the vehicle number data is the vehicle number data integrated by the vehicle number data integration unit.

3. The vehicle number data processing system according to Claim 2,

wherein, when the vehicle number data generation device performs the optical character recognition on an image captured by the corresponding imaging device and generates the vehicle number data including the information regarding the vehicle number of the number plate of the vehicle, the vehicle number data generation device generates the vehicle number data further including information regarding an initial time and information regarding a final time at which the vehicle is detected by the corresponding imaging device,

wherein the vehicle number data processing device further includes:

a character complementing unit configured to supplement a character of the vehicle number of a portion unrecognizable through the optical character recognition if the optical character recognition determination unit determines that the portion unrecognizable through the optical character recognition is contained in the vehicle number; and

a same-period-of-time searching unit configured to retrieve vehicle number data including the information regarding the initial time or the information regarding the final time corresponding to a period of time from the initial time to the final time included in vehicle number data obtained by performing the optical character recognition on the image captured by the one of the imaging devices, among vehicle number data obtained by performing the optical character recognition on images captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices, if (i) the optical character recognition determination unit determines that a portion unrecognizable through the optical character recognition is contained in the vehicle number or (ii) the same-vehicle-number searching unit fails to retrieve vehicle number data including information regarding the same vehicle number, and

wherein the same-vehicle-number searching unit retrieves vehicle number data

including the same information as information regarding the vehicle number in which the character is supplemented by the character complementing unit, among the vehicle number data retrieved by the same-period-of-time searching unit.

4. The vehicle number data processing system according to Claim 3,

wherein, when the vehicle number data generation device performs the optical character recognition on an image captured by the corresponding imaging device and generates the vehicle number data including the information regarding the vehicle number of the number plate of the vehicle, the vehicle number data generation devices generates the vehicle number data further including information regarding a kind of number plate of the vehicle,

wherein the vehicle number data processing device further includes a same-kind-of-number-plate searching unit configured to retrieve vehicle number data including the same information as information regarding the kind of number plate included in vehicle number data obtained by performing the optical character recognition on the image captured by the one of the imaging devices, among vehicle number data obtained by performing the optical character recognition on images captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices, if the same-vehicle-number searching unit fails to retrieve vehicle number data including information regarding the same vehicle number among the vehicle number data retrieved by the same-period-of-time searching unit, and

wherein, if the same-kind-of-number-plate searching unit retrieves one of vehicle number data, the vehicle number data integration unit integrates the retrieved vehicle number data and vehicle number data obtained by performing the optical character recognition on the image captured by the one of the imaging devices.

5. The vehicle number data processing system according to Claim 4,

wherein, when the vehicle number data generation device performs the optical character recognition on an image captured by the corresponding imaging device and generates the vehicle number data including the information regarding the vehicle number of the number plate of the vehicle, the vehicle number data generation devices generates the vehicle number data further including information regarding a vehicle speed of the vehicle,

wherein the vehicle number data processing device further includes a vehicle speed estimation unit configured to estimate a degree of accordance between the vehicle

speed indicated by information included in vehicle number data obtained by performing the optical character recognition on the image captured by the one of the imaging devices and the vehicle speed indicated by information included in vehicle number data obtained by performing the optical character recognition on the image captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices, if the same-kind-of-number-plate searching unit retrieves the plurality of vehicle number data, and

wherein the vehicle number data integration unit integrates the vehicle number data including information regarding the vehicle speeds of which the degree of accordance estimated by the vehicle speed estimation unit is high.

6. The vehicle number data processing system according to Claim 4 or 5,

wherein the vehicle number data processing device further includes a period-of-time estimation unit configured to estimate a degree of accordance between a period of time from the initial time to the final time indicated by information included in vehicle number data obtained by performing the optical character recognition on the image captured by the one of the imaging devices and a period of time from the initial time to the final time indicated by information included in vehicle number data obtained by performing the optical character recognition on the image captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices, if the same-kind-of-number-plate searching unit retrieves the plurality of vehicle number data, and

wherein the vehicle number data integration unit integrates the vehicle number data including information regarding the times of which the degree of accordance estimated by the period-of-time estimation unit is high.

7. The vehicle number data processing system according to any one of Claims 4 to 6,

wherein, when the vehicle number data generation device performs the optical character recognition on an image captured by the corresponding imaging device and generates the vehicle number data including the information regarding the vehicle number of the number plate of the vehicle, the vehicle number data generation device generates the vehicle number data further including information regarding a detection position of the vehicle, in regard to detection positions of all vehicles detected during a period of time in which the vehicle is detected by the corresponding imaging device,

wherein the vehicle number data processing device further includes a detection position estimation unit configured to estimate a degree of accordance between the detection position indicated by information included in vehicle number data obtained by performing the optical character recognition on the image captured by the one of the imaging devices and the detection position indicated by information included in vehicle number data obtained by performing the optical character recognition on the image captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices, if the same-kind-of-number-plate searching unit retrieves the plurality of vehicle number data, and

wherein the vehicle number data integration unit integrates the vehicle number data including information regarding the detection positions of which the degree of accordance estimated by the detection position estimation unit is high.

8. The vehicle number data processing system according to any one of Claims 4 to 7,

wherein the vehicle number data processing device further includes an imaging time determination unit configured to determine whether an imaging time of an image which is being subjected to the optical character recognition by each of the vehicle number data generation devices is a time prior to a final time at which a vehicle included in vehicle number data obtained by performing the optical character recognition on the image captured by the one of the imaging devices is detected, if the same-period-of-time searching unit or the same-kind-of-number-plate searching unit fails to retrieve the vehicle number data, and

wherein, if the imaging time determination unit determines that the imaging time is not the time prior to the final time, the vehicle number data integration unit sets vehicle number data obtained by performing the optical character recognition on the image captured by the one of the imaging devices as the integrated vehicle number data.

9. A vehicle number data processing method of processing vehicle number data including information regarding a vehicle number of a number plate of a vehicle obtained by performing optical character recognition on an image, the vehicle number data processing method comprising:

a vehicle number data integration step of reserving one of one piece of vehicle number data and another piece of vehicle number data along with deleting the other of the one piece of vehicle number data and the another piece of vehicle number data to thereby

integrate the vehicle number data including information regarding the same vehicle, wherein the one piece of vehicle number data include information regarding a vehicle number obtained by performing the optical character recognition on an image captured by one of the imaging devices installed so that imaging areas of a plurality of the imaging devices overlap each other and configured to continuously capture an image of a road, and the another piece of vehicle number data include information regarding a vehicle number obtained by performing the optical character recognition on an image captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices;

a same-vehicle-number retrieving step of retrieving vehicle number data including the same information as information regarding the vehicle number included in vehicle number data obtained by performing the optical character recognition on the image captured by the one of the imaging devices, among vehicle number data obtained by performing the optical character recognition on the images captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices;

an optical character recognition determination step of determining whether a portion unrecognizable through the optical character recognition is contained in a vehicle number obtained by performing the optical character recognition on the image captured by the one of the imaging devices;

a vehicle number position determination step of determining whether a position of a vehicle number obtained by performing the optical character recognition on the image captured by the one of the imaging devices in the image is within the imaging area of another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices; and

an integrated data determination step of determining whether the vehicle number data is the vehicle number data integrated in the vehicle number data integration step,

wherein the vehicle number data integration step includes integrating (i) vehicle number data obtained by performing the optical character recognition on the image captured by the one of the imaging devices and (ii) the vehicle number data retrieved in the same-vehicle-number retrieving step,

the same-vehicle-number retrieving step includes retrieving vehicle number data including the same information as information regarding the vehicle number if it is determined in the optical character recognition determination step that a portion

unrecognizable through the optical character recognition is not contained in the vehicle number,

the optical character recognition determination step includes determining whether a portion unrecognizable through the optical character recognition is contained in the vehicle number if it is determined in the vehicle number position determination step that the position of the vehicle number is within the imaging area of another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices, and

the vehicle number position determination step includes determining whether a position of a vehicle number included in the vehicle number data in the image is within the imaging area of another of the imaging devices if it is determined in the integrated data determination step that the vehicle number data is not the integrated vehicle number data.

10. A vehicle number data processing device of processing vehicle number data including information regarding a vehicle number of a number plate of a vehicle obtained by performing optical character recognition on an image, the vehicle number data processing device comprising:

a vehicle number data integration unit configured to reserve one of one piece of vehicle number data and another piece of vehicle number data along with deleting the other of the one piece of vehicle number data and the another piece of vehicle number data to thereby integrate the vehicle number data including information regarding the same vehicle, wherein the one piece of vehicle number data include information regarding a vehicle number obtained by performing the optical character recognition on an image captured by one of the imaging devices installed so that imaging areas of a plurality of the imaging devices overlap each other and configured to continuously capture an image of a road, and the another piece of vehicle number data include information regarding a vehicle number obtained by performing the optical character recognition on an image captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices;

a same-vehicle-number searching unit configured to retrieve vehicle number data including the same information as information regarding the vehicle number included in vehicle number data obtained by performing the optical character recognition on the image captured by the one of the imaging devices, among vehicle number data obtained by performing the optical character recognition on the images captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the

imaging devices;

an optical character recognition determination unit configured to determine whether a portion unrecognizable through the optical character recognition is contained in a vehicle number obtained by performing the optical character recognition on the image captured by the one of the imaging devices;

a vehicle number position determination unit configured to determine whether a position of a vehicle number obtained by performing the optical character recognition on the image captured by the one of the imaging devices in the image is within the imaging area of another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices; and

an integrated data determination unit configured to determine whether the vehicle number data is the vehicle number data integrated by the vehicle number data integration unit,

wherein the vehicle number data integration unit integrates (i) vehicle number data obtained by performing the optical character recognition on the image captured by the one of the imaging devices and (ii) the vehicle number data retrieved by the same-vehicle-number searching unit,

the same-vehicle-number searching unit retrieves vehicle number data including the same information as information regarding the vehicle number if the optical character recognition determination unit determines that a portion unrecognizable through the optical character recognition is not contained in the vehicle number,

the optical character recognition determination unit determines whether a portion unrecognizable through the optical character recognition is contained in the vehicle number if the vehicle number position determination unit determines that the position of the vehicle number is within the imaging area of another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices, and

the vehicle number position determination unit determines whether a position of a vehicle number included in the vehicle number data in the image is within the imaging area of another of the imaging devices if the integrated data determination unit determines that the vehicle number data is not the integrated vehicle number data.

11. A program causing a computer to function as a vehicle number data processing device that processes vehicle number data including information regarding a vehicle number of a number plate of a vehicle obtained by performing optical character recognition on an

image, the program causing the computer to function as:

a vehicle number data integration unit configured to reserve one of one piece of vehicle number data and another piece of vehicle number data along with deleting the other of the one piece of vehicle number data and the another piece of vehicle number data to thereby integrate the vehicle number data including information regarding the same vehicle, wherein the one piece of vehicle number data include information regarding a vehicle number obtained by performing the optical character recognition on an image captured by one of the imaging devices installed so that imaging areas of a plurality of the imaging devices overlap each other and configured to continuously capture an image of a road, and the another piece of vehicle number data include information regarding a vehicle number obtained by performing the optical character recognition on an image captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices;

a same-vehicle-number searching unit configured to retrieve vehicle number data including the same information as information regarding the vehicle number included in vehicle number data obtained by performing the optical character recognition on the image captured by the one of the imaging devices, among vehicle number data obtained by performing the optical character recognition on the images captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices;

an optical character recognition determination unit configured to determine whether a portion unrecognizable through the optical character recognition is contained in a vehicle number obtained by performing the optical character recognition on the image captured by the one of the imaging devices;

a vehicle number position determination unit configured to determine whether a position of a vehicle number obtained by performing the optical character recognition on the image captured by the one of the imaging devices in the image is within the imaging area of another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices; and

an integrated data determination unit configured to determine whether the vehicle number data is the vehicle number data integrated by the vehicle number data integration unit,

wherein the vehicle number data integration unit integrates (i) vehicle number data obtained by performing the optical character recognition on the image captured by the

one of the imaging devices and (ii) the vehicle number data retrieved by the same-vehicle-number searching unit,

the same-vehicle-number searching unit retrieves vehicle number data including the same information as information regarding the vehicle number if the optical character recognition determination unit determines that a portion unrecognizable through the optical character recognition is not contained in the vehicle number,

the optical character recognition determination unit determines whether a portion unrecognizable through the optical character recognition is contained in the vehicle number if the vehicle number position determination unit determines that the position of the vehicle number is within the imaging area of another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices, and

the vehicle number position determination unit determines whether a position of a vehicle number included in the vehicle number data in the image is within the imaging area of another of the imaging devices if the integrated data determination unit determines that the vehicle number data is not the integrated vehicle number data.

12. A recording medium that records a program causing a computer to function as a vehicle number data processing device that processes vehicle number data including information regarding a vehicle number of a number plate of a vehicle obtained by performing optical character recognition on an image, the recording medium that records the program causing the computer to function as:

a vehicle number data integration unit configured to reserve one of one piece of vehicle number data and another piece of vehicle number data along with deleting the other of the one piece of vehicle number data and the another piece of vehicle number data to thereby integrate the vehicle number data including information regarding the same vehicle, wherein the one piece of vehicle number data include information regarding a vehicle number obtained by performing the optical character recognition on an image captured by one of the imaging devices installed so that imaging areas of a plurality of the imaging devices overlap each other and configured to continuously capture an image of a road, and the another piece of vehicle number data include information regarding a vehicle number obtained by performing the optical character recognition on an image captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices;

a same-vehicle-number searching unit configured to retrieve vehicle number data

including the same information as information regarding the vehicle number included in vehicle number data obtained by performing the optical character recognition on the image captured by the one of the imaging devices, among vehicle number data obtained by performing the optical character recognition on the images captured by another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices;

an optical character recognition determination unit configured to determine whether a portion unrecognizable through the optical character recognition is contained in a vehicle number obtained by performing the optical character recognition on the image captured by the one of the imaging devices;

a vehicle number position determination unit configured to determine whether a position of a vehicle number obtained by performing the optical character recognition on the image captured by the one of the imaging devices in the image is within the imaging area of another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices; and

an integrated data determination unit configured to determine whether the vehicle number data is the vehicle number data integrated by the vehicle number data integration unit,

wherein the vehicle number data integration unit integrates (i) vehicle number data obtained by performing the optical character recognition on the image captured by the one of the imaging devices and (ii) the vehicle number data retrieved by the same-vehicle-number searching unit,

the same-vehicle-number searching unit retrieves vehicle number data including the same information as information regarding the vehicle number if the optical character recognition determination unit determines that a portion unrecognizable through the optical character recognition is not contained in the vehicle number,

the optical character recognition determination unit determines whether a portion unrecognizable through the optical character recognition is contained in the vehicle number if the vehicle number position determination unit determines that the position of the vehicle number is within the imaging area of another of the imaging devices having the imaging area overlapping the imaging area of the one of the imaging devices, and

the vehicle number position determination unit determines whether a position of a vehicle number included in the vehicle number data in the image is within the imaging area of another of the imaging devices if the integrated data determination unit determines that the

vehicle number data is not the integrated vehicle number data.