

DESCRIPTION
ANALYSIS SYSTEM

Field

[0001] The present invention relates to an analysis
5 system.

Background

[0002] As a conventional analysis system, for example,
Patent Literature 1 has disclosed an information display
system including a passage information acquisition unit, an
10 information output unit, and a display unit. The passage
information acquisition unit acquires passage information
about the passage of people. The information output unit
selectively outputs the information on the basis of the
passage information acquired by the passage information
15 acquisition unit. The display unit displays the
information output selectively by the information output
unit on the place where the person corresponding to the
passage information passes. This information display
system displays the information in accordance with the
20 number of passing people on the basis of the passage
information acquired by the passage information acquisition
unit, for example, and thus can charge in accordance with
the effect of displaying the information.

Citation List

25 Patent Literature

[0003] Patent Literature 1: Japanese Patent Application
Laid-open No. 2003-302923

Summary

Technical Problem

30 [0004] Incidentally, in the system as described above,
for example, indices expressing the tendency of mobility of
people at an arbitrary point or area including the number
of passing people and various indices calculated based on

the number of those people may be used for various purposes such as trading area researches, marketing, advertisement, materials in determining advertisement rates, disaster preventing planning, and urban designing. An analysis system may analyze the tendency of the mobility of people in routes where mobile objects such as buses travel and also in these cases, it has been desired to analyze the tendency of the mobility of people properly.

[0005] The present invention has been made in view of the above circumstances, and an object thereof is to provide an analysis system that can analyze the tendency of the mobility of people properly.

Solution to Problem

[0006] In order to solve the above mentioned problem and achieve the object, an analysis system according to the present invention includes a plurality of data collection devices mounted on a plurality of respective mobile objects that travel in a plurality of routes and collecting analysis data including image data expressing an image inside the mobile object and position data expressing a position at which the image inside the mobile object is captured; and a data analysis device that counts number of passengers in the mobile objects for each of the routes based on the analysis data collected by the data collection devices.

[0007] Further, in the analysis system, it is possible to configure that the data analysis device counts the number of passengers based on number of persons included in the image expressed by the image data.

[0008] Further, in the analysis system, it is possible to configure that the data analysis device extracts the number of passengers in the mobile object that has traveled in a particular one of the routes from the analysis data

collected by the data collection devices based on the position data included in the analysis data, aggregates the numbers of passengers, in the particular route, in all the mobile objects that have traveled in the particular route, and counts a total number of passengers in all the mobile objects in the particular route.

[0009] Further, in the analysis system, it is possible to configure that the data analysis device analyzes an attribute of a person included in the image expressed by the image data for each of the routes based on the analysis data.

[0010] Further, in the analysis system, it is possible to configure that the mobile objects each include an output device mounted internally, the output device being able to output contents, and the data analysis device calculates an index expressing number of persons having passed a receivable range where the contents output from the output device are receivable for each of the routes based on the number of passengers for each of the routes.

Advantageous Effects of Invention

[0011] An analysis system according to the present invention can collect analysis data including image data expressing an image inside each mobile object and position data by using a plurality of data collection devices each mounted on each mobile object. In addition, the data analysis device can count the number of passengers in the mobile objects for each of a plurality of routes on the basis of the analysis data collected by the data collection devices. As a result, this analysis system obtains an effect that the tendency of the mobility of people can be analyzed properly.

Brief Description of Drawings

[0012] FIG. 1 is a block diagram illustrating a

schematic structure of an analysis system according to a first embodiment.

FIG. 2 is a diagram illustrating one example of the number of passengers in one mobile object that is an analysis target of the analysis system according to the first embodiment.

FIG. 3 is a schematic diagram illustrating one example of a route where one mobile object that is an analysis target of the analysis system according to the first embodiment travels.

FIG. 4 is a schematic diagram illustrating one example of a plurality of routes where a plurality of mobile objects that are analysis targets of the analysis system according to the first embodiment travel.

FIG. 5 is a chart expressing one example of the number of passengers for each of the mobile objects that are the analysis targets of the analysis system according to the first embodiment.

FIG. 6 is a chart illustrating one example of the number of passengers for each of the routes that are the analysis targets of the analysis system according to the first embodiment.

FIG. 7 is a chart illustrating one example of the number of passengers for each of the routes that are the analysis targets of the analysis system according to the first embodiment.

FIG. 8 is a schematic diagram illustrating one example of analysis result data analyzed and processed in the analysis system according to the first embodiment.

FIG. 9 is a flowchart expressing one example of a process in the analysis system according to the first embodiment.

Description of Embodiments

[0013] Embodiments of the present invention are hereinafter described in detail with reference to the drawings. Note that the present invention is not limited by these embodiments. The components described in the
5 embodiments below include the components that can be replaced or easily conceivable by a person skilled in the art and the components that are substantially the same.

[0014] First embodiment

An analysis system 1 according to the present
10 embodiment illustrated in FIG. 1 includes recording devices 10 as a plurality of data collection devices, and an analysis device 20 as a data analysis device. The analysis system 1 supplies analysis result data resulting from the analysis of the analysis device 20 to a client terminal CL.
15 The analysis system 1 according to the present embodiment is to, by using the recording devices 10 in mobile objects V, analyze the tendency of the mobility of people on the basis of the image data collected by the recording devices 10. The analysis system 1 according to the present
20 embodiment achieves the structure capable of analyzing the tendency of the mobility of people properly for each route in a manner of combining pieces of analysis data collected by the recording devices 10 mounted on the mobile objects V that travel in the respective routes. The structure of the
25 analysis system 1 is described in detail with reference to each drawing.

[0015] The recording device 10 is mounted on the mobile object V and collects the analysis data used for the analysis by the analysis device 20. The analysis data
30 collected by the recording device 10 is the data including image data and position data. The image data is the data expressing the image inside the mobile object V. The position data is the data expressing the position at which

the image inside the mobile object V is captured. The recording device 10 collects the image data and the position data as the analysis data. The analysis data is used to analyze the tendency of the mobility of people by the analysis device 20.

[0016] Here, the mobile object V on which the recording device 10 is mounted is typically an object configured to be able to travel in a plurality of routes that are determined in advance. Typical examples of the mobile objects V include vehicles running on a road, such as a private car, a rental car, a sharing car, a ride sharing car, a bus, a taxi, a truck, a carrier, and a service car. The mobile object V is not limited to a vehicle and may be, for example, a flying object flying in the sky, such as a flying car or a drone. For example, the mobile object V described in the present embodiment is a fixed-route bus that travels repeatedly in a plurality of predetermined routes in a day. As for the mobile object V such as a fixed-route bus, for example, one mobile object V may travel in a plurality of routes in a day while a plurality of mobile objects V, in a plurality of routes, are selectively used and travel in order to make the allocation of buses efficient. Each of the recording devices 10 according to the present embodiment is mounted on each of the mobile objects V that travel in the routes. That is to say, the analysis system 1 according to the present embodiment includes the recording devices 10 mounted on the respective mobile objects V that travel in the routes, and can collect the analysis data from the recording devices 10.

[0017] Specifically, the recording device 10 includes an internal camera 11, a positional information measurement unit 12, a data input/output unit 13, and a control unit 14. The recording device 10 may be, for example, an on-vehicle

device mounted on the mobile object V, such as what is called a driving recorder, but the recording device 10 is not limited to this example.

[0018] The internal camera 11 is an internal imaging
5 device that captures an image inside the mobile object V, that is, inside the vehicle. The internal camera 11 captures the image inside the mobile object V and collects the image data expressing the image inside the mobile object V. The internal camera 11 typically captures a
10 moving image inside the mobile object V. The internal camera 11 is installed in the mobile object V at such an angle of view that makes it possible to capture an image of a person to be analyzed by the analysis system 1, here, the passenger in the vehicle of the mobile object V, for
15 example. A plurality of the internal cameras 11 may be provided on the ceiling or the like inside the mobile object V so that the image of the person inside the mobile object V can be captured more suitably. The internal camera 11 may be either a monocular camera or a stereo
20 camera. The image captured by the internal camera 11 may be either monochromatic or color. The control unit 14 is connected with the internal camera 11 so that communication therebetween is possible, and can exchange various signals and data with the internal camera 11. The internal camera
25 11 outputs the collected image data to the control unit 14.

[0019] The positional information measurement unit 12 is a measurement unit that measures the current position of the mobile object V. The positional information measurement unit 12 may be, for example, a global
30 positioning system (GPS) receiver that receives electric waves transmitted from a GPS satellite. The positional information measurement unit 12 receives the electric waves from the GPS satellite and acquires the GPS information

(latitude and longitude coordinates) as the information expressing the current position of the mobile object V, and thus collects the position data expressing the position at which the image inside the mobile object V is captured.

5 The positional information measurement unit 12 is connected with the control unit 14 so that communication therebetween is possible, and outputs the collected position data to the control unit 14.

[0020] The data input/output unit 13 inputs and outputs
10 various data between the recording device 10 and a device different from the recording device 10. The data input/output unit 13 according to the present embodiment can output the analysis data to the analysis device 20 that is the device different from the recording device 10. The
15 data input/output unit 13 may have a structure of inputting and outputting the data to and from the device different from the recording device 10 by communication through a network (with or without wires). In addition, the data input/output unit 13 may have a structure of including a
20 slot part and inputting and outputting the data to and from the device different from the recording device 10 through a recording medium inserted into the slot part. Here, the recording medium is, for example, a memory (removable medium) detachably attached to the recording device 10
25 through the slot part. The recording medium is, for example, a memory card with various formats, such as an SD card, but the recording medium is not limited to this example.

[0021] The control unit 14 is to control generally each
30 part of the recording device 10. The control unit 14 executes various calculation processes for collecting the analysis data. The control unit 14 is formed by including an electronic circuit mainly including a known

microcomputer including a central calculation processing device such as a central processing unit (CPU) or a graphics processing unit (GPU), a read only memory (ROM), a random access memory (RAM), and an interface. The control
5 unit 14 is connected with each of the internal camera 11, the positional information measurement unit 12, the data input/output unit 13, and the like so that communication therebetween is possible, and can exchange various signals and data with these parts.

10 [0022] More specifically, the control unit 14 includes a storage unit 14A and a processing unit 14B. The storage unit 14A and the processing unit 14B can exchange various signals and data with each unit. The storage unit 14A stores therein, conditions and information necessary in
15 various processes in the processing unit 14B, various computer programs, applications, and control data executed in the control unit 14, and the like. The storage unit 14A can store therein the analysis data together with the time at which the analysis data is collected, for example. In
20 other words, the analysis data includes the time data expressing the time at which the data is collected and other pieces of data. For example, the storage unit 14A can temporarily store therein various pieces of data generated in the process performed by the processing unit
25 14B. The data in the storage unit 14A is read out as necessary by the processing unit 14B, the data input/output unit 13, and the like. The storage unit 14A may be a storage device with relatively large capacity, such as a hard disk, a solid state drive (SSD), or an optical disk,
30 or a semiconductor memory capable of rewriting data, such as a RAM, a flash memory, or a non-volatile static random access memory (NVSRAM). The processing unit 14B executes various computer programs stored in the storage unit 14A on

the basis of various input signals and the like and by the operation of the computer programs, outputs output signals to the respective units and executes various processes for achieving various functions. The processing unit 14B
5 controls the operation of the internal camera 11 and the positional information measurement unit 12 to perform the process of collecting the analysis data including the image data and the position data. In addition, the processing unit 14B performs the process about the input and output of
10 the data through the data input/output unit 13. The processing unit 14B, for example, performs the process of outputting the analysis data to the analysis device 20 through the data input/output unit 13.

[0023] The analysis device 20 analyzes the analysis data
15 collected by the recording device 10 and provides the analysis result data expressing the analysis result to the client terminal CL. The analysis device 20 and the client terminal CL may be cloud service type devices (cloud server) mounted on the network, or may be what is called
20 stand-alone type devices that are separated from the network. The analysis device 20 according to the present embodiment counts the number of passengers in the mobile objects V for each of the routes on the basis of the analysis data collected by the recording devices 10. In
25 addition, the analysis device 20 according to the present embodiment analyzes the attribute of the person included in the image expressed by the image data for each of the routes on the basis of the analysis data collected by the recording devices 10. Then, the analysis device 20
30 according to the present embodiment generates the analysis result data based on the result of counting the number of passengers in the mobile object V for each route and the analysis result about the attribute of the person in the

mobile object V, and provides the analysis result data to the client terminal CL.

[0024] The analysis device 20 performs various calculation processes for counting the number of passengers in the mobile objects V for each route on the basis of the analysis data. In addition, the analysis device 20 performs various calculation processes for analyzing the attribute of the person in the mobile object V on the basis of the analysis data. The analysis device 20 is formed by including an electronic circuit mainly including a known microcomputer including a central calculation processing device such as a CPU or a GPU, a ROM, a RAM, and an interface. The analysis device 20 can be formed when applications for achieving various processes to be described below are installed in a known personal computer (PC) or a computer system such as a workstation. In addition, the analysis device 20 may be configured by combining a plurality of PCs so that mutual communication is possible.

[0025] Specifically, the analysis device 20 includes a data input/output unit 21, a storage unit 22, and a processing unit 23. The data input/output unit 21, the storage unit 22, and the processing unit 23 can exchange various signals and data with each unit.

[0026] The data input/output unit 21 inputs and outputs various pieces of data between the analysis device 20 and the device that is different from the analysis device 20. The data input/output unit 21 according to the present embodiment can input the analysis data from the recording device 10 that is the device different from the analysis device 20. Moreover, the data input/output unit 21 according to the present embodiment can output the analysis result data to the client terminal CL that is the device

different from the analysis device 20. In a manner similar to the data input/output unit 13, the data input/output unit 21 may be configured to input and output the data to and from the device different from the analysis device 20
5 by communication through the network (with or without wires), for example. Similarly, the data input/output unit 21 may have a structure of including a slot part and inputting and outputting the data to and from the device different from the analysis device 20 through the recording
10 medium inserted in the slot part.

[0027] The storage unit 22 stores therein, conditions and information necessary in various processes in the processing unit 23, various computer programs, applications, and control data executed in the processing unit 23, and
15 the like. The storage unit 22 can store therein, the analysis data that is input by the data input/output unit 21. The storage unit 22 can temporarily store various pieces of data generated in the process performed by the processing unit 23. The data in the storage unit 22 is
20 read out as necessary by the data input/output unit 21, the processing unit 23, and the like. The storage unit 22 may be a storage device with relatively large capacity, such as a hard disk, an SSD, or an optical disk, or a semiconductor memory capable of rewriting data, such as a RAM, a flash
25 memory, or an NVSRAM.

[0028] More specifically, the storage unit 22 is formed conceptually in terms of functions by including an analysis target database (hereinafter abbreviated as "analysis target DB") 22A, an analysis reference database
30 (hereinafter abbreviated as "analysis reference DB") 22B, and an analysis result database (hereinafter abbreviated as "analysis result DB") 22C.

[0029] The analysis target DB 22A is a part that stores

therein the database formed by accumulating the analysis data (image data, position data, time data, etc.) that is the analysis target data by the processing unit 23. The analysis data input from the recording device 10 to the data input/output unit 21 is stored in this analysis target DB 22A.

[0030] The analysis reference DB 22B is a part that stores therein the database formed by accumulating the analysis reference data that is referred to when the processing unit 23 analyzes the analysis data. The analysis reference data includes, for example, map reference data, attribute prediction reference data, and the like. The map reference data is the data expressing the map referred to when the position of the mobile object V, that is, the position where the image inside the mobile object V is captured is specified on the basis of the position data or the like. The attribute prediction reference data is the data referred to when the attribute of the person included in the image expressed by the image data is presumed, for example. The attribute prediction reference data is described in detail below. The analysis reference data is referred to when the processing unit 23 analyzes the analysis data.

[0031] The analysis result DB 22C is a part that stores therein the database formed by accumulating the analysis result data expressing the analysis result of the analysis data by the processing unit 23. The analysis result data is the data based on the result of counting the number of passengers in the mobile object V for each route (the data of the number of passengers per route), the result of analyzing the attribute of the person in the mobile object V (the person attribute data), or the like. The analysis result data is processed into a desired format by the

processing unit 23, and output and provided from the data input/output unit 21 to the client terminal CL.

[0032] Note that various kinds of data stored in the analysis target DB 22A, the analysis reference DB 22B, and
5 the analysis result DB 22C can be used as what is called big data (big data).

[0033] The processing unit 23 executes various computer programs stored in the storage unit 22 on the basis of various input signals and the like, and by the operation of
10 the computer programs, performs various processes for analyzing the analysis data. Moreover, the processing unit 23 performs the process of processing the analysis result data into the desired format. The processing unit 23 also performs the process about the data input/output through
15 the data input/output unit 21. The processing unit 23, for example, performs the process of outputting the analysis result data processed into the desired format to the client terminal CL through the data input/output unit 21.

[0034] More specifically, the processing unit 23 is
20 formed conceptually in terms of functions by including a data preprocessing unit 23A, a data analysis processing unit 23B, and a data processing unit 23C.

[0035] The data preprocessing unit 23A is a part that preprocesses variously the analysis data that is the
25 analysis target data. As the preprocessing, for example, the data preprocessing unit 23A reads out the analysis data that is the analysis target data from the analysis target DB 22A, and performs a process of cutting out a still image from a moving image expressed by the image data included in
30 the analysis data. As the preprocessing, the data preprocessing unit 23A performs the process of associating the cut still image, the position expressed by the position data included in the analysis data that is the analysis

target data, and the time expressed by the time data included in the analysis data that is the analysis target data.

[0036] The data analysis processing unit 23B is a part
5 that counts the number of passengers in the mobile objects V for each of the routes on the basis of the analysis data that has been subjected to the preprocessing by the data preprocessing unit 23A.

[0037] Typically, the data analysis processing unit 23B
10 counts the number of passengers in each mobile object V that is the analysis target on the basis of the image data included in the analysis data that has been subjected to the preprocessing by the data preprocessing unit 23A. Here, the data analysis processing unit 23B counts the number of
15 passengers in each mobile object V on the basis of the number of persons included in the image expressed by the image data. The data analysis processing unit 23B performs a process of detecting and extracting the person from the still image cut by the data preprocessing unit 23A on the
20 basis of the image data using various known image processing techniques. Then, the data analysis processing unit 23B counts the number of detected and extracted persons, and calculates the number of counted persons as the number of passengers in the mobile object V.

[0038] Note that the data preprocessing unit 23A may
25 detect and extract the person included in the image expressed by the image data for the entire collected image data or for just the image data collected in a predetermined period including the time of opening and
30 closing the door of the fixed-route bus forming the mobile object V. In this case, the data preprocessing unit 23A may specify the image data collected in the predetermined period on the basis of the image expressed by the image

data or specify in advance the image data collected in the predetermined period by various known methods by using the opening or closing of the door of the fixed-route bus as a trigger when the image data is collected by the recording device 10.

[0039] Upon the detection of the person from the image expressed by the image data, the data analysis processing unit 23B reads out the position data and the time data associated with the image data where the person is detected, from the analysis target DB 22A. Then, the data analysis processing unit 23B specifies the time and the position of the mobile object V when the image data including the detected person is collected, on the basis of the read position data and time data and the map reference data (analysis reference data) stored in the analysis reference DB 22B. Then, the data analysis processing unit 23B specifies the time and the position of the mobile object V when the image inside the mobile object V is captured, sorts this in time series, and specifies the number of passengers in the mobile object V for each time and each position.

[0040] Then, on the basis of the specified position and time of the mobile object V, the data analysis processing unit 23B specifies the route, among the predetermined routes, where the mobile object V for which the number of passengers is counted travels and the time when the mobile object V travels in that route. Then, the data analysis processing unit 23B specifies the mobile object V for which the number of passengers is counted, the route where the mobile object V travels, the time when the mobile object V travels in that route, and the number of passengers in the mobile object V at the specified route/time, and associates these pieces of information with each other.

[0041] As the analysis result data resulting from the analysis of the analysis data, the data analysis processing unit 23B generates the data of the number of passengers per mobile object including the specified various pieces of information as described above. The data of the number of passengers per mobile object is the data about the number of passengers for each mobile object V, and the data expressing the mobile object V for which the number of passengers is counted, the number of passengers in the mobile object V for each time/position, the route where the mobile object V travels, the time when the mobile object V travels in the route, the number of passengers in the mobile object V at the specified route/route, and the like. Then, the data analysis processing unit 23B accumulates the analysis result data including the generated data of the number of passengers per mobile object in the analysis result DB 22C to form the database, and stores the database in the analysis result DB 22C.

[0042] FIG. 2 illustrates the number of passengers for each mobile object V included in the data of the number of passengers per mobile object generated by the data analysis processing unit 23B, for example, and expresses the number of passengers in the mobile object V in a route R1 where the mobile object (fixed-route bus) V illustrated in FIG. 3 travels. FIG. 2 illustrates the number of passengers in the mobile object V per unit time that is set in advance arbitrarily. Here, FIG. 2 illustrates the number of passengers for one week (seven days) and the unit time is 24 hours, that is, one day, and also illustrates the average per week. Note that the unit time when the number of passengers is expressed is not limited to a day and may be set arbitrarily. For example, the unit time may be either shorter or longer (this similarly applies below).

The data analysis processing unit 23B can count the number of passengers per unit time that is set arbitrarily.

[0043] The data analysis processing unit 23B according to the present embodiment performs the aforementioned
5 process of counting the number of passengers inside the mobile object V for each of the entire mobile objects V that travel in the routes. Then, the data analysis processing unit 23B counts the number of passengers in the mobile objects V for each of the routes. That is to say,
10 the data analysis processing unit 23B aggregates the numbers of passengers in the entire mobile objects V in a particular route among the multiple routes, and counts the total number of passengers (total passengers) in the entire mobile objects V in the particular route.

15 [0044] More specifically, the data analysis processing unit 23B according to the present embodiment extracts, from the analysis data collected by the recording devices 10, the number of passengers in the mobile object V that travels in a particular route among the routes on the basis
20 of the position data included in the analysis data. In this case, the data analysis processing unit 23B may extract the data of the number of passengers per mobile object in the mobile object V that travels in the particular route from the data of the number of passengers
25 per mobile object described above, and extract the number of passengers in the mobile object V that travels in the particular route. The data analysis processing unit 23B may extract the analysis data collected in the mobile object V that travels in the particular route from the
30 analysis data collected by the recording devices 10, and extract the number of passengers in the mobile object V that travels in the particular route. That is to say, the data analysis processing unit 23B aggregates the numbers of

passengers in the particular route in the number of passengers in all the mobile objects V that travel in the extracted particular route, and counts the total number of passengers (total passengers) in the entire mobile objects V in the particular route.

[0045] A specific example of counting the number of passengers in the mobile objects V in the particular route by the data analysis processing unit 23B is described with reference to FIG. 4, FIG. 5, FIG. 6, and FIG. 7. In the example described below, four mobile objects V, that is, a bus A, a bus B, a bus C, and a bus D travel in three routes, that is, a route R21, a route R22, and a route R23 illustrated in FIG. 4. In this example, as illustrated in FIG. 5, the bus A, the bus C, and the bus D travel in all the three routes of the route R21, the route R22, and the route R23, and the bus B travels only in the two routes of the route R21 and the route R22 among the three routes.

[0046] In this case, the data analysis processing unit 23B extracts the number of passengers in all the mobile objects V that travel in the particular route from the analysis data collected by the recording devices 10 on the basis of the position data included in the analysis data that has been subjected to the preprocess performed by the data preprocessing unit 23A. In this example, the data analysis processing unit 23B extracts the number of passengers for each of all the mobile objects V that travel in the route R21 as the particular route, the number of passengers for each of all the mobile objects V that travel in the route R22 as the particular route, and the number of passengers for each of all the mobile objects V that travel in the route R23 as the particular route. As illustrated in FIG. 5, here, the data analysis processing unit 23B extracts the number of passengers for each of all the

mobile objects V including the bus A, the bus B, the bus C, and the bus D as the number of passengers in each of the mobile objects V that travel in the route R21. Similarly, the data analysis processing unit 23B extracts the number
5 of passengers for each of all the mobile objects V including the bus A, the bus B, the bus C, and the bus D as the number of passengers in each of the mobile objects V that travel in the route R22. Then, the data analysis processing unit 23B extracts the number of passengers for
10 each of the three mobile objects V including the bus A, the bus C, and the bus D except the bus B as the number of passengers in each of the mobile objects V that travel in the route R23.

[0047] FIG. 5 illustrates one example of the extracted
15 number of passengers for each of the mobile objects V in each of the routes R21, R22, and R23 for each of the mobile objects V and each unit time. Here, in FIG. 5, the unit time is three hours and the number of passengers in one day is illustrated. Moreover, FIG. 5 illustrates the number of
20 passengers for each of the mobile objects V for every three hours in one business day from the operation start time 6:00 to the operation end time 18:00. Note that FIG. 5 also illustrates the total number of passengers in the mobile objects V regardless of the routes R21, R22, and R23,
25 and the total number of passengers in each time zone regardless of the routes R21, R22, and R23.

[0048] Then, the data analysis processing unit 23B aggregates the numbers of passengers in each of the routes R21, R22, and R23 in the entire mobile objects V that
30 travel in the extracted particular routes R21, R22, and R23, and totals the numbers. Thus, the data analysis processing unit 23B counts the total numbers of passengers (total passengers) in all the mobile objects V in each of the

routes R21, R22, and R23. FIG. 6 illustrates the total number of passengers in the entire mobile objects V in the routes R21, R22, and R23 in the case where the unit time is one business day (one day) in the example illustrated in FIG. 5. In this case, the data analysis processing unit 23B aggregates and totals, as the number of passengers in one business day in the route R21, the number of passengers in the bus A from 6:00 to 9:00, the number of passengers in the bus B from 9:00 to 12:00, the number of passengers in the bus C from 15:00 to 18:00, and the number of passengers in the bus D from 12:00 to 15:00. Thus, the total number of passengers in the route R21 for one business day can be counted (see "330" in FIG. 6). Similarly, the data analysis processing unit 23B aggregates and totals, as the number of passengers in one business day in the route R22, the number of passengers in the bus A from 9:00 to 12:00 and from 12:00 to 15:00, the number of passengers in the bus B from 6:00 to 9:00, from 12:00 to 15:00, and from 15:00 to 18:00, the number of passengers in the bus C from 6:00 to 9:00 and from 9:00 to 12:00, and the number of passengers in the bus D from 15:00 to 18:00. Thus, the total number of passengers in the route R22 for one business day can be counted (see "900" in FIG. 6). Furthermore, the data analysis processing unit 23B aggregates and totals, as the number of passengers in one business day in the route R23, the number of passengers in the bus A from 15:00 to 18:00, the number of passengers in the bus C from 12:00 to 15:00, and the number of passengers in the bus D from 6:00 to 9:00 and from 9:00 to 12:00. Thus, the total number of passengers in the route R23 for one business day can be counted (see "225" in FIG. 6). Note that FIG. 6 also illustrates the total number of passengers totaling the numbers of passengers for one

business day in the routes R21, R22, and R23.

[0049] In addition, as illustrated in FIG. 7, the data analysis processing unit 23B can combine the numbers of passengers in the routes R21, R22, and R23 for one business
5 day so as to count the number of passengers for each of the routes R21, R22, and R23. In a manner similar to FIG. 2, FIG. 7 illustrates, assuming that the unit time is 24 hours, that is, daily, the number of passengers in all the mobile objects V in the routes R21, R22, and R23 for one week
10 (seven days). FIG. 7 also illustrates the average per week of the numbers of passengers in all the mobile objects V in the routes R21, R22, and R23 and the total number of passengers of each day without specifying the routes R21, R22, and R23.

15 [0050] The data analysis processing unit 23B generates the data of the number of passengers per route including various kinds of information that is specified as described above, as the analysis result data resulting from the analysis of the analysis data. The data of the number of
20 passengers per route is the data about the number of passengers for each route, and is the data expressing the route for which the number of passengers is counted and the total number of passengers in all the mobile objects V for each route, for example. Then, the data analysis
25 processing unit 23B accumulates the analysis result data including the generated data of the number of passengers per route in the analysis result DB 22C to form the database, and stores the database in the analysis result DB 22C.

30 [0051] In addition, the data analysis processing unit 23B according to the present embodiment is also the part that analyzes the attribute of the person included in the image expressed by the image data on the basis of the

analysis data that has been subjected to the preprocessing by the data preprocessing unit 23A.

[0052] The data analysis processing unit 23B analyzes the attribute of the person detected and extracted from the still image cut out by the data preprocessing unit 23A on the basis of the image data. Typically, the data analysis processing unit 23B analyzes the attribute of the person included in the image expressed by the image data for each of the aforementioned routes. In this case, the data analysis processing unit 23B extracts the analysis data collected in the mobile object V traveling in the particular route on the basis of the position data and the like, from the analysis data collected by the recording devices 10. Then, by analyzing the attribute of the person included in the image expressed by the image data on the basis of the extracted analysis data, the data analysis processing unit 23B analyzes the attribute of the person in each mobile object V for each of the routes. In the examples described with reference to FIG. 4, FIG. 5, FIG. 6, and FIG. 7, the data analysis processing unit 23B analyzes the attribute of the person included in the image expressed by the image data on the basis of the analysis data collected in the mobile object V traveling in each route for each of the route R21, the route R22, and the route R23. Here, the data analysis processing unit 23B is configured to be able to perform the process of analyzing the attribute of the person included in the image expressed by the image data or analyzing the mobility of the person with the attribute specified, by using various known artificial intelligence (Artificial Intelligence) techniques and deep learning (Deep Learning) techniques.

[0053] Specifically, the data analysis processing unit 23B performs the process of detecting and extracting the

person from the still image cut out by the data preprocessing unit 23A as described above. Then, the data analysis processing unit 23B according to the present embodiment performs the process of extracting the image including the characteristic point of the person detected and extracted from the image expressed by the image data. Here, the characteristic point of the person is the part that can specify the attribute of the person included in the image. The characteristic point of the person is, for example, the face where the person's emotion is expressed, hands and feet where the behavior or gesture is expressed, or the part at the position where the accessories or the like are easily worn. The data analysis processing unit 23B extracts the image including the characteristic point of the person that can be used to specify the attribute of the person, from many images captured at different angles, for example.

[0054] Then, on the basis of the image including the characteristic point of the person extracted from the image data, the data analysis processing unit 23B performs the process of analyzing the attribute of the person included in the image. The data analysis processing unit 23B analyzes the attribute of the person on the basis of the attribute prediction reference data (analysis reference data) stored in the analysis reference DB 22B and the characteristic point of the person included in the image extracted from the image data. Here, the attribute prediction reference data is the information reflecting the result of learning the attribute of the person that can be presumed in accordance with the characteristic point of the person included in the image, for example, by various methods using the artificial intelligence technique or the deep learning technique. In other words, the attribute

prediction reference data is the data made into the database with various methods using the artificial intelligence technique or the deep learning technique to presume the attribute of the person on the basis of the characteristic point of the person included in the image, for example. This attribute prediction reference data can be updated sequentially. The attribute prediction reference data may be, for example, the data for learning the analysis result data (person attribute data) itself that expresses the analysis result by the data analysis processing unit 23B.

[0055] The attribute of the person to be analyzed by the data analysis processing unit 23B typically includes, for example, the items that can be analyzed in terms of the external characteristic point of the person, such as sex, age, physique, social status, liking, and action orientation of the person. Here, the sex is the attribute that expresses whether the person is a male or a female. The age is the attribute that expresses the length of years and months since the person was born up to the present day (that time). The physique is the attribute that expresses the height, weight, and other various sizes. The social status is the attribute that expresses the occupation (self-employed, businessman, police officer, student, unemployed, part-time worker), annual income, social position, companion, and the like. The liking is the attribute that expresses the taste of cloths, belongings, and fashion (likes casual, elegant, famous brands, high-end cloths, or fast fashion), and hobbies (sport/subculture/outdoor/beauty, etc.), for example. The action orientation is the attribute that expresses the mood or interest at that time (what the person wants to do or where he/she wants to go). Here, the data analysis

processing unit 23B presumes the sex, age, physique, social status, liking, action orientation, and the like as the attribute of the person.

[0056] With reference to the attribute prediction
5 reference data, the data analysis processing unit 23B extracts the attribute (sex, age, physique, social status, liking, or action orientation) corresponding to the characteristic point of the person included in the image, and presumes the extracted attribute as the attribute of
10 the person existing in the image. The data analysis processing unit 23B refers to the attribute prediction reference data in accordance with the facial expression, the behavior or gesture of the hands or feet, or the worn accessory or cloths, which is the characteristic point of
15 the person in the image, and matches the attribute corresponding to the characteristic point, and presumes the attribute of the person, such as sex, age, physique, social status, liking, or action orientation.

[0057] Moreover, the data analysis processing unit 23B
20 performs the process of analyzing the position or the like of the person with the attribute specified as above on the basis of the position data associated with the image data where the attribute of the person is specified. The data analysis processing unit 23B reads out the position data
25 associated with the image data with the attribute of the person specified, from the analysis target DB 22A, for example. Then, the data analysis processing unit 23B analyzes the position of the person with the attribute specified on the basis of the map reference data (analysis
30 reference data) stored in the analysis reference DB 22B and the read position data. For example, the data analysis processing unit 23B specifies the position at which the image is captured on the basis of the position data with

reference to the map reference data. Then, the data analysis processing unit 23B specifies the position of the person with the attribute specified on the basis of the position expressed by the position data.

5 [0058] The data analysis processing unit 23B generates the person attribute data expressing the attribute of the person analyzed as above and the position data per attribute expressing the position of the person with the attribute specified as the analysis result data resulting
10 from the analysis of the analysis data. Then, the data analysis processing unit 23B accumulates the analysis result data including the generated person attribute data and the position data per attribute in the analysis result DB 22C to form the database, and stores the database in the
15 analysis result DB 22C.

[0059] Note that the mobile object V in which the recording device 10 according to the present embodiment is mounted includes an output device OD internally. The output device OD is a device that can output contents, and
20 is provided internally in each of the mobile objects V. The output device OD may be a cloud service type device that is mounted on the network and provides various contents through the network, or may be what is called a stand-alone type device that is separated from the network.
25 The output device OD includes a display that can display images in accordance with the contents, a speaker that can output sound and voice in accordance with the contents, and the like. The contents output from the output device OD may include, for example, advertisement and coupons, and
30 moreover area information and route information to a predetermined facility, an evacuation route/safety support information in emergency, and other various guidance information. The data of the contents output from the

output device OD can be updated sequentially through the network, the recording medium, or the like.

[0060] The data analysis processing unit 23B according to the present embodiment may be configured to be able to perform a process of generating commercial-use data based on the data of the number of passengers per mobile object, the data of the number of passengers per route, or the like as the analysis result data. Specifically, the data analysis processing unit 23 according to the present embodiment calculates the index expressing the number of persons having passed the range where the contents from the output device OD provided inside each mobile object V can be received. Here, the range where the contents from the output device OD can be received is the spatial range where the person can receive the contents output from the output device OD, and is determined in accordance with the range where the person can see the image displayed by the output device OD, the range where the person can hear the sound or voice output from the output device OD, or the like.

[0061] For example, the data analysis processing unit 23 calculates the index expressing the number of persons having passed the aforementioned receivable range for each route on the basis of the data of the number of passengers per route expressing the number of passengers for each route. Additionally, the data analysis processing unit 23 may calculate the index expressing the number of persons having passed the aforementioned receivable range for each mobile object V on the basis of the data of the number of passengers per mobile object expressing the number of passengers for each mobile object V. Then, the data analysis processing unit 23 generates the commercial-use data expressing the index, accumulates the analysis result data including the generated commercial-use data in the

analysis result DB 22C to form the database, and stores the database in the analysis result DB 22C.

[0062] Here, the number of persons having passed the range where the contents from the aforementioned output device OD can be received can be regarded as the number of persons having received the contents from the output device OD. In the case where the output device OD is set inside the mobile object V, the receivable range can be regarded typically as the entire part inside the mobile object V. Therefore, the number of persons having passed the range where the contents from the output device OD inside the mobile object V can be received can be regarded as being substantially the same as the number of passengers in the mobile object V.

[0063] In view of the above, the data analysis processing unit 23B according to the present embodiment employs the number of passengers in the mobile object V as the number of persons in the range where the contents can be received. That is to say, here, the data analysis processing unit 23B employs the number of passengers for each mobile object V expressed by the data of the number of passengers per mobile object, as the number of persons in the range where the contents can be received for each mobile object V. Similarly, the data analysis processing unit 23B employs the number of passengers for each route expressed by the data of the number of passengers per route, as the number of persons in the range where the contents can be received for each route.

[0064] Then, the data analysis processing unit 23B may employ the number of persons having passed the content receivable range as the index expressing the number of persons having passed, or may calculate the index expressing the number of persons having passed on the basis

of the number of persons having passed. As the index expressing the number of persons having passed that is calculated by the data analysis processing unit 23B, for example, "DEC: daily effective circulation", "GRP: gross rating point", and the like are given. "DEC" and "GRP" are the indices that express the advertising effect. "DEC" is typically the number of persons who pass in one day the range where the target advertisement can be received (viewable range). "DEC" may be, for example, the number of persons having passed targeting the people who satisfy a predetermined age restriction, for example those who are aged 18 or over, or the number of persons having passed targeting all the people regardless of the age. "GRP" is typically the ratio of the number of persons who pass in a day the aforementioned receivable range to the target population in an area where people can reach the target advertisement in a day. "GRP" can be expressed by "DEC/target population in target area". In the case where the age of the target of "DEC" is restricted, "target population in target area" is the population that satisfies the age restriction in the target area.

[0065] The data analysis processing unit 23B can calculate "DEC" and "GRP" for each mobile object V as the index expressing the number of persons having passed on the basis of the number of persons having passed the content receivable range for each mobile object V. For example, the number of passengers in a day for each mobile object V described above with reference to FIG. 2, the average thereof, the total number of passengers in the mobile objects V described with reference to FIG. 5, or the like correspond to "DEC" for each mobile object V.

[0066] Similarly, the data analysis processing unit 23B can calculate "DEC" and "GRP" for each route as the index

expressing the number of passengers on the basis of the number of passengers in the content receivable range for each route. For example, the number of passengers in a day for each route described above with reference to FIG. 6 and FIG. 7, and the average thereof correspond to "DEC" for each route.

[0067] The data analysis processing unit 23B generates the commercial-use data expressing "DEC" and "GRP" for each route and for each mobile object V as the index expressing the number of persons having passed the receivable range. The analysis result data including the generated commercial-use data is accumulated in the analysis result DB 22C and made into the database, which is then stored therein.

[0068] The data processing unit 23C is a part that performs a process of processing the analysis result data analyzed by the data analysis processing unit 23B into a desired format. The data processing unit 23C processes the data of the number of passengers per mobile object, the data of the number of passengers per route, the person attribute data, the people mobility data per attribute, the commercial-use data, and the like included in the analysis result data into the desired format. As illustrated in FIG. 8, for example, the data processing unit 23C processes the analysis result data including the data of the number of passengers per mobile object, the data of the number of passengers per route, the person attribute data, the people mobility data per attribute, and the commercial-use data into plots on the map, various graphs, diagrams, and the like in the form of "DEC" or "GRP" for each mobile object V, "DEC" or "GRP" for each route, or the like expressing the time, the point on the route, the attribute of people, and the number of people. Then, the processing unit 23

performs the process of outputting the analysis result data processed into the desired format by the data processing unit 23C to the client terminal CL through the data input/output unit 21. The client terminal CL is the

5 terminal that enables the use of the analysis result data provided from the analysis device 20 in various purposes including, for example, trading area researches, marketing, advertisement, materials in determining advertisement rates, disaster preventing planning, and urban designing.

10 Examples of the client terminal CL include a laptop PC, a desktop PC, a tablet PC, a smartphone, and a mobile terminal.

[0069] Next, one example of the process in the analysis system 1 is described with reference to a flowchart in FIG.

15 9.

[0070] First, the recording devices 10 mounted on the mobile objects V collect the analysis data including the image data and the position data in accordance with the travel of the mobile objects V (step S1).

20 [0071] Next, the recording device 10 outputs the collected analysis data through the data input/output unit 13 and inputs the data to the analysis device 20 through the data input/output unit 21 of the analysis device 20 (step S2). The analysis data input to the analysis device

25 20 is stored in the analysis target DB 22A.

[0072] Next, the data preprocessing unit 23A in the analysis device 20 performs various preprocessing as described above on the analysis data stored in the analysis target DB 22A (step S3).

30 [0073] Then, the data analysis processing unit 23B of the analysis device 20 performs the analysis on the basis of the analysis data that has been preprocessed by the data preprocessing unit 23A, and generates the data of the

number of passengers per mobile object, the data of the number of passengers per route, the person attribute data, the people mobility data per attribute, and the commercial-use data (step S4).

5 [0074] Subsequently, the data analysis processing unit 23B accumulates the generated analysis result data including the data of the number of passengers per mobile object, the data of the number of passengers per route, the person attribute data, the people mobility data per
10 attribute, and the commercial-use data to form the database and stores the database in the analysis result DB 22C (step S5).

[0075] Next, the data processing unit 23C of the analysis device 20 processes the analysis result data
15 stored in the analysis result DB 22C (the data of the number of passengers per mobile object, the data of the number of passengers per route, the person attribute data, the people mobility data per attribute, the commercial-use data, and the like) in accordance with the request from the
20 client terminal CL or the like into the desired format as illustrated in FIG. 8 (step S6).

[0076] Then, the processing unit 23 of the analysis device 20 outputs and provides the analysis result data processed into the desired format by the data processing
25 unit 23C to the client terminal CL through the data input/output unit 21 (step S7) and ends a series of processes.

[0077] The analysis system 1 described above can collect the analysis data including the image data expressing the
30 image inside each mobile object V and the position data by the recording devices 10 mounted on the mobile objects V. Then, the analysis device 20 can count the number of passengers in the mobile objects V for each of the routes

on the basis of the analysis data collected by the recording devices 10. That is to say, even in the case where one mobile object V travels in a plurality of routes in a day while a plurality of mobile objects V travel in the routes in order to make the allocation of buses efficient, for example, this analysis system can count properly not just the number of passengers for each mobile object V but also the total number of passengers in each route that is associated with each route, for example.

10 Accordingly, this analysis system 1 can analyze the tendency of the mobility of people properly for each of the routes where the mobile objects V travel. Additionally, the analysis system 1 can use the tendency of the mobility of people for each of the routes that is analyzed as above in various purposes such as trading area research, marketing, advertisement, materials in determining advertisement rates, disaster preventing planning, and urban designing.

[0078] Here, the analysis system 1 described above counts the number of passengers in the mobile object V on the basis of the number of people included in the image expressed by the image data. Thus, the analysis system 1 can drastically improve the frequency of counting the number by reducing the workload in counting as compared to the case in which the number of passengers in the mobile object V is counted manually with human eyes, for example. As a result, the analysis system 1 can analyze the tendency of the mobility of people more accurately.

[0079] More specifically, the analysis system 1 described above extracts the number of passengers in the mobile object V that has traveled in the particular route from the analysis data collected by the recording devices 10, aggregates the number of passengers in the particular

route for all the mobile objects V that have traveled in the particular route, and counts the total number of passengers in all the mobile objects V in the particular route. Therefore, the analysis system 1 can properly count
5 the total number of passengers in all the mobile objects for each of the routes on the basis of the analysis data collected by the recording devices 10.

[0080] In the analysis system 1 described above, the analysis device 20 further analyzes the attribute of the
10 person included in the image expressed by the image data for each of the routes on the basis of the analysis data. As a result, this analysis system 1 can also analyze the attribute of the person in the mobile object V in addition to the number of passengers in the mobile object V as the
15 tendency of the mobility of people for each of the routes where the mobile objects V travel. Accordingly, this analysis system 1 can help to find the tendency of the attribute of the passenger for each of the routes in addition to the number of passengers for each route where
20 the mobile objects V travel, and on the contrary, easily specify the route where there are many passengers with the desired attribute and tendency, for example. Thus, the analysis system 1 can use the tendency of the mobility of people for each route more suitably in various applications
25 as above.

[0081] In one example, in the analysis system 1 described above, the analysis device 20 calculates the index expressing the number of persons having passed the range where the contents from the output device OD mounted
30 on the mobile object V can be received, for each route, on the basis of the number of passengers for each of the routes. As a result, the analysis system 1 can use the index for each route more suitably as a material in

determining the usage fee (advertisement rate) of the contents output from the output device OD for each route, for example. In addition, the analysis system 1 can suitably use the attribute and the tendency of the passenger for each route as, for example, the material in determining the contents output from the output device OD in the mobile object V for each route.

[0082] Note that the analysis system according to the embodiment of the present invention described above is not limited to the aforementioned embodiment and various changes are possible in the range described in the scope of claims.

[0083] The mobile object V described above has the output device OD mounted internally; however, the present invention is not limited to this structure. The analysis device 20 calculates the index expressing the number of persons having passed the range where the contents from the output device OD can be received, for each of the routes; however, the present invention is not limited to this structure.

[0084] The analysis device 20 described above analyzes the attribute of the person included in the image expressed by the image data for each of the routes; however, the present invention is not limited to this structure.

[0085] The control unit 14 and the analysis device 20 described above may have each unit configured as a separate body and the units may be connected to each other so that various electric signals can be exchanged therebetween. Moreover, one function may be achieved by another control device. The computer programs, the applications, various data, and the like described above may be updated as appropriate and may be stored in a server connected to the analysis system 1 through an arbitrary network. The

computer programs, the applications, various data, and the like described above may be, for example, downloaded partially or entirely as necessary. In another example, the processing functions of the control unit 14 and the analysis device 20 may be achieved, in the entire parts or an arbitrary part, by a CPU or the like or by computer programs that are construed and executed by the CPU or the like, or may be achieved by hardware such as wired logic.

[0086] For example, in the analysis system 1, some functions of the data preprocessing unit 23A and the data analysis processing unit 23B of the analysis device 20 may be provided on each recording device 10 side. For example, the analysis system 1 may perform primary image analysis, such as cutting an outer peripheral image including a person on each recording device 10 side, and then perform secondary image analysis, such as counting the number of passengers or analyzing the person attribute, on the analysis device 20 side in accordance with the data based on the analysis data transmitted from each recording device 10 to the analysis device 20. In another example, the analysis system 1 may count the number of passengers in each mobile object V individually on the recording device 10 side and generate the data of the number of passengers per mobile object, and in accordance with the data based on the analysis data transmitted from each recording device 10 to the analysis device 20, count the number of passengers in the mobile objects V for each route on the analysis device 20 side and generate the data of the number of passengers per route.

Reference Signs List

[0087] 1 ANALYSIS SYSTEM

10 RECORDING DEVICE (DATA COLLECTION DEVICE)

11 INTERNAL CAMERA

12 POSITIONAL INFORMATION MEASUREMENT UNIT
13, 21 DATA INPUT/OUTPUT UNIT
14 CONTROL UNIT
14A, 22 STORAGE UNIT
5 14B, 23 PROCESSING UNIT
20 ANALYSIS DEVICE (DATA ANALYSIS DEVICE)
22A ANALYSIS TARGET DB
22B ANALYSIS REFERENCE DB
22C ANALYSIS RESULT DB
10 23A DATA PREPROCESSING UNIT
23B DATA ANALYSIS PROCESSING UNIT
23C DATA PROCESSING UNIT
CL CLIENT TERMINAL
OD OUTPUT DEVICE
15 R1, R21, R22, R23 ROUTE
V MOBILE OBJECT

CLAIMS

1. An analysis system comprising:
a plurality of data collection devices mounted on a plurality of respective mobile objects that travel in a plurality of routes and collecting analysis data including
5 image data expressing an image inside the mobile object and position data expressing a position at which the image inside the mobile object is captured; and
a data analysis device that counts number of
10 passengers in the mobile objects for each of the routes based on the analysis data collected by the data collection devices.
2. The analysis system according to claim 1, wherein
15 the data analysis device counts the number of passengers based on number of persons included in the image expressed by the image data.
3. The analysis system according to claim 1 or 2, wherein
20 the data analysis device extracts the number of passengers in the mobile object that has traveled in a particular one of the routes from the analysis data collected by the data collection devices based on the position data included in the analysis data, aggregates the
25 numbers of passengers, in the particular route, in all the mobile objects that have traveled in the particular route, and counts a total number of passengers in all the mobile objects in the particular route.
- 30 4. The analysis system according to any one of claims 1 to 3, wherein
the data analysis device analyzes an attribute of a person included in the image expressed by the image data

for each of the routes based on the analysis data.

5. The analysis system according to any one of claims 1 to 4, wherein

5 the mobile objects each include an output device mounted internally, the output device being able to output contents, and

the data analysis device calculates an index expressing number of persons having passed a receivable
10 range where the contents output from the output device are receivable for each of the routes based on the number of passengers for each of the routes.