Pedestrian Navigation System with 3D Map and Charging Server Based on Steganography

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***Abstract*—A pedestrian navigation system with a steganography-based 3D map and billing server is proposed. The proposed system includes a server system that provides topographical maps and navigation information to both pedestrians and vehicles. When using the proposed system, necessary images of cross sections, intersections, or points of interest can be automatically obtained, similar to the Street View feature in Google Maps. Users can post photos taken with their camera phones and earn points if the photos are marked as posted. While the proposed system incurs a usage fee, these points can be used to reduce the subscription fee. If the quality of an image is superior to that of a previously archived image, the new image overwrites the previous one. The billing system for the system usage fee incorporates digital steganography for security reasons. This prevents the leakage of user information and other data. Through experiments, it is confirmed that the proposed system works well.**

Keywords—Pedestrian navigation; steganography; client-server system; geographic information; system; GIS

I. Introduction

The proposed system relates to a map information providing system that provides map information, particularly to a map information providing system that targets map information that is three-dimensional information [1]. As a background art of the proposed system, there is a position information management system disclosed in Japanese Patent Laid-Open No. 2003-111128. The position information management system of this background art is a data storage unit for storing map data and data for receiving landscape image data of a landscape around a user's information communication terminal from the information communication terminal via a communication line.

A configuration including a receiving unit, a current position specifying unit that specifies a current position where the information communication terminal is located based on the landscape image data received by the data receiving unit, and the map data stored in the data storage unit. According to the position information management system of the background art, when the position information from the GPS satellites is used without using the position information from the GPS satellites or the position information by the three-point survey method from a plurality of base stations in the vicinity.

The current position of the information communication terminal can be specified with the same high position accuracy. Further, the following technical matters are also disclosed in the publication.

- Specify the position based on the orientation data, in addition to the landscape image data.
- Identify the location using the area information of the base station.
- Update stored map data based on landscape image data.
- Navigate to the destination specified by the user.

The position information management system of background art cannot perform position identification using GPS in an environment such as a building or an underground mall, where it is difficult to receive radio waves from GPS satellites. In view of the above, the present invention has been made for the purpose of specifying the current position of the information communication terminal with the same high position as in the case of using GPS. However, the position information management system of the background art is configured as described above and has the following problems.

1) The map data is updated using the landscape image data captured by the user's information communication terminal, but the landscape image data is mistakenly updated because GPS is not used.

2) Landscape image data taken by the user's information communication terminal is taken at the user's discretion, and the landscape image data as planned by the system side cannot be acquired, resulting in poor-quality map data overall.

3) The scenery image data is repeatedly updated every time when it is uploaded to the system side, the load on the system side increases, and the scenery does not change frequently, so there is a lot of waste of updating itself.

The proposed system has been made to solve the above problems, and an object thereof is to provide a map information system in which image data relating to map information is appropriately updated.

In the following section, related research works are described. The proposed system is described in the next section, followed by some experiments. The conclusion is described with some discussions.

II. Related Research Works

An introduction to map matching for personal navigation assistants is provided [2]. Also, measurement and processing of indoor GPS signals using one-shot software receiver is conducted and well reported [3].

On foot navigation: continuous step calibration using both complementary recursive prediction and adaptive Kalman filtering is proposed [4]. Meanwhile, advanced integration of Wi-Fi and inertial navigation systems for indoor mobile positioning is proposed and experienced [5].

Performance analysis of MEMS based pedestrian navigation systems is made [6]. On the other hand, 3D map creation with vehicle-mounted single stereo camera, reducing the influence due to vehicle motions, is proposed and validated its performance [7].

A moving domestic robot control method based on creating and sharing maps with shortest path finding and obstacle avoidance is proposed and evaluated its performance [8]. Meanwhile, color radio-map interpolation for efficient fingerprint Wi-Fi-based indoor location estimation is proposed [9].

Mapping and simulating watershed performances based on GIS, remote sensing, and SWAT are conducted and well reported [10]. On the other hand, communication links and evacuation/navigation information services for the tsunami warning system are introduced and experienced [11].

A seamless location measurement system with WiFi beacon utilized and GPS-based systems in both Indoor and outdoor receiver location measurement is proposed and evaluated for its performance [12]. Real-time monitoring visual impaired person’s geolocation and walking state activity using GPS is also proposed [13].

Monitoring of visually impaired person movement using WEMOS di mini-GPS is also proposed [14].

As for digital steganography technology, a noble method for data hiding using steganography, discrete wavelet transformation, and cryptography, Triple Data Encryption Standard: TDES is proposed.

III. Proposed Method

A. System Concept

A map information providing apparatus according to the proposed system is an apparatus that transmits three-dimensional map information in response to a request from a mobile communication terminal equipped with a GPS receiver, and a three-dimensional map based on positioning information received from the mobile communication terminal. Means for reading the corresponding three-dimensional map information from the information storage means, means for reading the corresponding satellite image from the satellite image storage means based on the positioning information or the read three-dimensional map information, and imaging based on the positioning information or the read three-dimensional map information It includes a unit for reading the captured image from the image storage unit and a unit for pasting the satellite image and the captured image on the three-dimensional map information.

As described above, in the proposed system, the three-dimensional map information is read based on the positioning information from the mobile communication terminal, and the satellite image and the captured image are read as the images required for the three-dimensional map information and the satellite image is included in the three-dimensional map information.

Since the captured image is pasted and provided to the user, the satellite image and the captured image are interpolated with each other to provide the three-dimensional map information having a highly accurate real image.

The mobile communication terminal is a terminal that is portable and capable of communication, and specifically corresponds to a mobile phone, a PHS, a PDA including a communication device, and a notebook computer including a communication device. The captured image is an image captured by a mobile phone with a camera, a digital camera, a vehicle-mounted camera, or the like.

The satellite image may be attached to the top surface of the building and the road, and the captured image may be attached to the side surface of the object having the side surface (the road normally does not have the side surface). Alternatively, the captured image may be pasted where there is a captured image, and the satellite image may be pasted to other places. It is also possible to adopt a configuration in which one of the images is pasted first and then the other image is pasted on top of it.

A map information providing system according to the proposed system is a map information providing system including a mobile communication terminal equipped with an imaging device and a GPS receiver, and a map information providing apparatus that transmits three-dimensional map information in response to a request from the mobile communication terminal. Then, the map information providing device reads the corresponding three-dimensional map information from the three-dimensional map information storage means based on the positioning information received from the mobile communication terminal, and the captured image storage means based on the positioning information or the read three-dimensional map information.

The mobile communication terminal includes means for reading the captured image from the device, means for pasting the captured image on the three-dimensional map information, and means for recording the captured image from the mobile communication terminal in the captured image storage means based on the positioning information. It includes means for displaying the outline of the object in the three-dimensional map information based on the three-dimensional map information during the imaging mode.

In this way, in the proposed system, when capturing an image with the mobile communication terminal, the outlines of objects such as buildings, traffic lights, and intersections in the three-dimensional map information are displayed based on the three-dimensional map information, and the user matches the outline. It is possible to perform imaging, the map information providing apparatus can store an appropriate captured image assumed by the map information providing side, and it is possible to provide the user with three-dimensional map information to which a high-quality captured image is pasted.

The outline does not have to display the outline of all objects. For example, only the outline of the object located in the center may be used. The outline corresponds to a part of the frame (preferably hidden line processing) when the three-dimensional model is displayed in the wire frame.

In the map information providing system according to the proposed system, if necessary, the map information providing device transmits the positioning to the mobile communication terminal when a new captured image is needed from the captured image situation stored in the captured image storage means. It further includes means for requesting image pickup based on information.

As described above, in the proposed system, when the map information providing device determines that a new captured image is necessary according to the captured image situation of the captured image storage means, the image is captured based on the positioning information transmitted from the mobile communication terminal. When it is determined that the user is at a required position, the mobile communication terminal of the user is requested to capture an image, so that the user can capture an image required by the map providing device while suppressing the cost, and it is possible to collect high-quality captured images by the outline.

Here, "from the captured image status stored in the captured image storage means" means that, for example, when there is no captured image at a certain location, when there is a captured image, but the capture date is old, or there is a captured image, but at a specific time. This corresponds to the case where the captured image is insufficient. It is also a matter that the device operator can set appropriately.

A map information providing apparatus according to the proposed system is a map information providing apparatus that transmits three-dimensional map information in response to a request from a mobile communication terminal equipped with an imaging device and a GPS receiver, as necessary, and received from the mobile communication terminal. A means for reading the corresponding three-dimensional map information from the three-dimensional map information storage means based on the positioning information, a means for reading the corresponding captured image from the captured image storage means based on the positioning information or the read three-dimensional map information, and three-dimensional map information.

A means for pasting the captured image, a means for performing a route search from the current position and the destination when the destination is set from the mobile communication terminal, positioning information from the mobile communication terminal, and a mobile phone at the time of capturing the captured image. It includes means for identifying the image pickup direction of the communication terminal and creating information for guiding in the route direction using the image pickup direction and the route direction.

In this way, in the proposed system, the imaging direction of the mobile phone at the time of imaging is specified from the positioning information from the mobile communication terminal and the captured image, and the route to the destination and the information for guiding from the imaging direction to the route direction are created, By receiving the guidance by the mobile phone and outputting the guidance, the user can be guided in the correct direction without having to compare the surrounding situation with the 3D map information. The information to be guided corresponds to the information of the arrow in the route direction, the image of the correct route direction, and the image from the imaging direction to the route direction (may be a discontinuous image or a panoramic image).

A map information providing apparatus, according to the proposed system, is a map information providing apparatus that transmits three-dimensional map information in response to a request from a mobile communication terminal equipped with an imaging device and a GPS receiver as necessary and received from the mobile communication terminal. A means for reading the corresponding three-dimensional map information from the three-dimensional map information storage means based on the positioning information, a means for reading the corresponding captured image from the captured image storage means based on the positioning information or the read three-dimensional map information, and three-dimensional map information.

A means for pasting the captured image, a means for the map information providing device to store the positioning information and the embedded information from the mobile communication terminal in the embedded information storage means, and a transmission to the mobile communication terminal at the request of the mobile communication terminal 3 It includes means for including embedded information in the area of the three-dimensional map information in the three-dimensional map information.

As described above, in the proposed system, the positioning information and the embedded information from the mobile communication terminal are stored in the embedded information storage means and related to the three-dimensional map information to be transmitted, as well as the three-dimensional map information in response to the request of the mobile communication terminal. By including the embedded information to be provided to the user, the information registered by another user can be shared by the user who receives the information. It is possible to construct a so-called peer-to-peer usage mode in which information is directly exchanged between an unspecified number of individuals.

The map information providing apparatus or the map information providing system according to the proposed system embeds the management information in a hidden format and the management information in the image to be transmitted to the mobile communication terminal by the map information providing apparatus, if necessary. And a means for recording the recorded image. As described above, in the proposed system, since the management information is embedded in the image transmitted to the mobile communication terminal in a hidden format, it is possible to discriminate against an illegally used image and to record the image in which the management information is embedded. Since it is present, it can be used as evidence that it is the information already provided.

The map information providing system according to the proposed system additionally includes, if necessary, means for subtracting the charging information of the owner of the mobile communication terminal when the captured image to be recorded in the captured image storage means is received from the mobile communication terminal. It is a waste.

As described above, in the proposed system, when the captured image storage means is constructed using the captured image from the mobile communication terminal, the billing information regarding the use of the map information providing device for the user who provided the captured image by subtracting, it is possible to take an incentive for the user to take an image using the mobile communication terminal. The above outline of the proposed system does not enumerate the features that are essential to the proposed system, and a sub-combination of a plurality of these features can also be the proposed system.

B. System Configuration

Fig. 1 is a system configuration diagram of a map information system according to this embodiment.

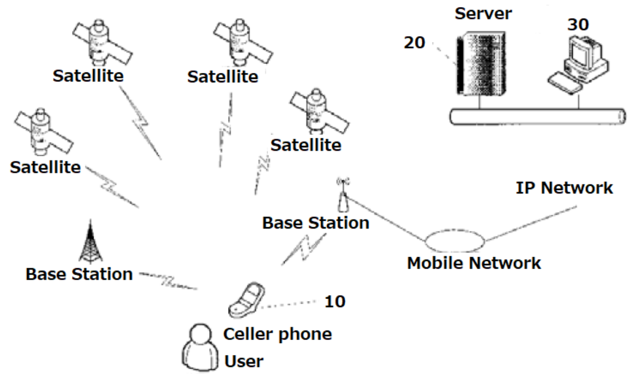

Fig. 1. System configuration diagram.

The map information system according to the present embodiment includes a mobile phone 10 with a GPS function and a camera function for receiving a radio wave from a GPS satellite and a reference station to identify a current position, a mobile phone 10, a base station, a mobile communication network, and an IP network. It is configured to include a server 20 that can communicate with the mobile phone 10 by transmitting the recorded three-dimensional map information to the mobile phone 10. In addition, a management computer 30 that operates and manages the map information system is also arranged.

Fig. 2 is a hardware configuration diagram of the components of the map information system according to this embodiment. Server 20 is built on a computer and has a hardware configuration such as a CPU (Central Processing Unit) 21, a main memory such as a DRAM (Dynamic Random Access Memory) 22, an external storage device HD (hard disk) 23, and a display device. A display 24, a keyboard 25, and a mouse 26, which are input devices, a LAN card 27, which is an expansion card for connecting to a network, a CD-ROM drive 28, and the like.

For example, the server program stored in the CD-ROM is duplicated (installed) on the HD 23, the server program is read into the main memory 22 as necessary, and the CPU 21 executes the program so that the server (device) Make up. Also, the management computer 30 has substantially the same hardware configuration as the computer on which the server 20 is constructed. Strictly speaking, the computer on which server 20 is constructed uses hardware with high performance and high reliability.

Most of the hardware configurations of the mobile phone 10 is the same as that of a computer, and instead of having no keyboard and mouse as input devices, a plurality of push buttons is provided on the surface of the main body, and a device and a camera function that enable mobile communication are realized. An example is a configuration in which a device that enables the realization and a device that receives a GPS radio wave and specifies the current position are mounted and are different.

The hardware configuration described here is an example, and it is obvious that those skilled in the art can make changes. Also, as for GPS, a plurality of methods such as single positioning, relative positioning, DGPS positioning, RTK-GPS positioning, etc., are prepared.

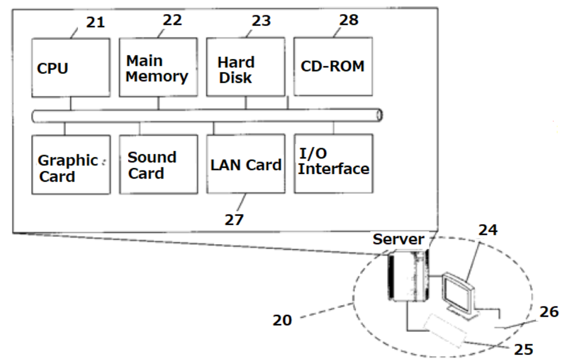

Fig. 2. Required functionality of the server.

Fig. 3 is a system configuration block diagram of the map information system according to the present embodiment. Server 20 is configured to have the following components.

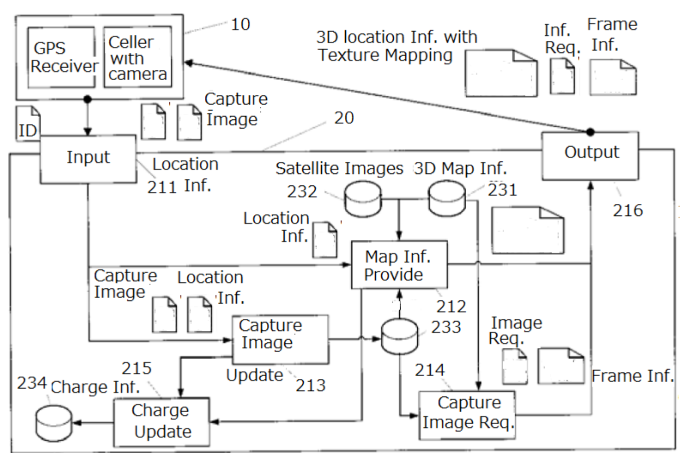

Fig. 3. System configuration.

Input means for capturing positioning information, captured images, etc. from the mobile phone 10. The corresponding three-dimensional map information is read from the three-dimensional map information storage unit 231 based on the captured positioning information, the satellite image is read from the satellite image storage unit 232 based on the positioning information, and the captured image storage unit 233 is read based on the positioning information.

A map information providing unit 212 that reads out the corresponding captured image and texture maps the satellite image and the captured image on the three-dimensional map information. The captured image updating unit 213 that records the captured image in the captured image storage unit 233 based on the positioning information.

Picked image requesting means 214 for making an image pickup request to the user when updating is necessary from the picked-up image storage means 233 based on the positioning information.

Point updating means 215 for updating the charging information based on the information provided by the map information providing means to the user.

An output unit 216 that sends out three-dimensional map information, an image pickup request, frame information, and the like to the mobile phone 10. Next, the operation of the map information providing system according to this embodiment will be described. The operation according to the present embodiment is a three-dimensional map display operation of displaying three-dimensional map information on which a real image is mapped on the user's mobile phone 10, and a captured image captured by the user's mobile phone 10 as three-dimensional map information. A captured image update operation of storing a mapable image, and a captured image request operation of requesting a captured image user to map to three-dimensional map information, and storing a captured image captured in response to the request in a mapable manner with three-dimensional map information.

C. 3D Map Display Operation

Fig. 4 is a flowchart of the three-dimensional map display operation according to this embodiment. First, the user uses the push button of the mobile phone 10 to select the map information providing service. Then, the mobile phone 10 receives radio waves from the GPS satellite and the reference station and obtains positioning information (step 101). The obtained positioning information is sent to server 20 via the communication path established between the mobile phone 10 and the server 20. Server 20 (map information providing means 212) reads out the three-dimensional map information required for display from the three-dimensional map information storage means 231 based on this positioning information (step 111).

Server 20 (the map information providing unit 212) reads out the satellite image and the captured image required for mapping from the satellite image storage unit 232 and the captured image storage unit 233 based on the positioning information (step 112). Although the image is read out based on the positioning information, it goes without saying that the image may be read out based on the read three-dimensional map information.

The server 20 (map information providing means 212) maps the read satellite image and captured image to three-dimensional map information. Here, mapping can be performed using various mapping techniques such as texture mapping. As a rule, a satellite image is pasted on the upper surface of the 3D map model and a captured image is pasted on the side surface of the 3D map model.

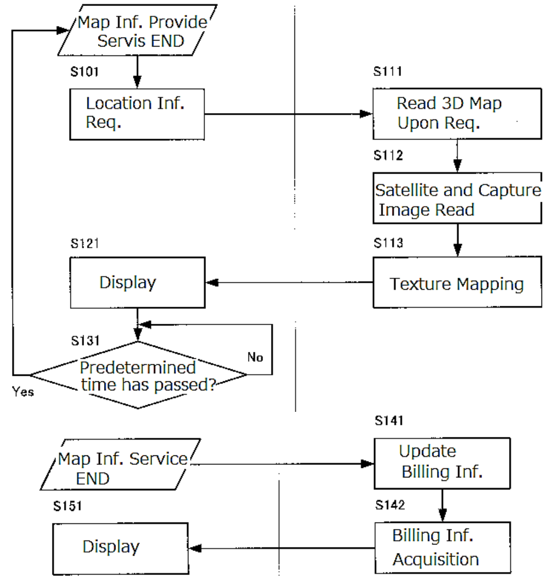

Fig. 4. Flowchart of the three-dimensional map display operation.

Since satellite images can also be obtained from the perspective direction, they may be attached to the side surface in some cases. The mapping here can, of course, be automated, but an operator can paste it instead. Server 20 sends the mobile phone 10 three-dimensional map information, in which the satellite image and the captured image are mapped. The mobile phone 10 fetches the three-dimensional map information and displays the three-dimensional model on the display.

The user can see the three-dimensional map information of the surrounding area. Here, the transmitted 3D map information may be information in a very limited range of the current position of the user, or may be 3D map information of a certain predetermined rectangular area. It is necessary to capture the 3D map information described above at any time according to the movement of the user. In the latter case, if the user moves to some extent, it is not necessary to capture new 3D map information within the rectangular area range.

The mobile phone 10 determines whether a predetermined time has passed from the previous step 101 (step 131), returns to step 101 if it determines that it has passed, and returns to step 131 if it determines that it has not passed. Return. Here, the three-dimensional map information to be fetched is updated every predetermined time, but the configuration may return to step 101 in accordance with the update of the positioning information. At this time, the positioning information may simply be updated, or when the moving distance from the previous step 101 exceeds a predetermined threshold value, the process may return to step 101.

Although the map information providing service is implemented in this way, when the user presses the push button of the mobile phone 10 and selects the end of the map information providing service, the service end signal is received and the server 20 (billing the updating means 215) adds the charging information (step 141). The billing information may be added based on the amount of the map providing service provided. The accounting information added by the server 20 (account updating means 215) is acquired (step 142). The acquired billing information is sent to mobile phone 10.

The mobile phone 10 displays the billing information on the display (step 151). The user can see the billing information. It should be noted that between the mobile phone 10 and the server 20, information (for example, a mobile phone number or a member ID assigned when registering to receive a service) that identifies the user of the mobile phone 10 is used as necessary. There is a need. It is necessary at least for billing renewal. The same applies below.

D. Captured Image Update Operation

Fig. 5 is a flowchart of the captured image update operation according to this embodiment.

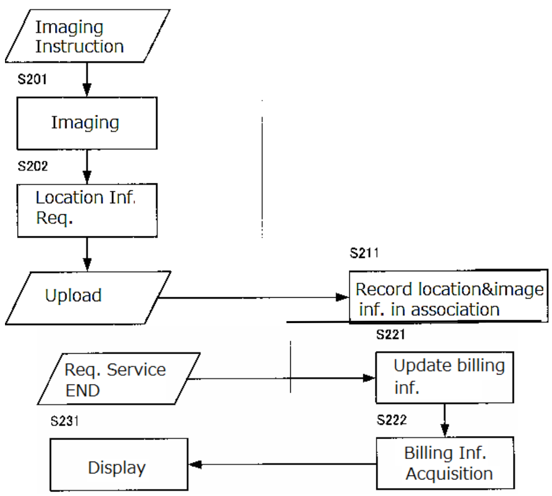

Fig. 5. Flowchart of the proposed imaging process.

First, the user uses the push button of the mobile phone 10 to select an image capturing instruction during the map information providing service (it may not be in service). The mobile phone 10 carries out imaging in accordance with the imaging instruction (step 201).

The mobile phone 10 obtains positioning information at the time of image pickup (step 202). The user uses the push button of the mobile phone 10 to select the upload of the captured image. The captured image and the positioning information are sent to Server 20. The server 20 (captured image updating means 213) stores the positioning information and the captured image in the captured image storage means 233 in association with each other (step 211). If a picked-up image of the same positioning information already exists, the picked-up image just stored is updated.

However, it is possible to retain the previously captured image, and it is possible to provide the three-dimensional map information in which the captured image of high quality is mapped by the confirmation of the operator. Instead of operator confirmation, noise determination processing for noise inclusion, scale determination processing to determine the scale of the captured image by edge processing of buildings, etc. From the image, the cutout processing to cut out the necessary image from the scale is automated. It can also be configured to.

When the user presses the push button of the mobile phone 10 and selects the end of the map information providing service, the service end signal is received, and in addition to the addition of the charge for the map information providing service, the server 20 (charge updating means 215) subtracts the billing information (step 221).

The billing information may be subtracted based on the number of uploaded captured images. The accounting information updated by the server 20 (account updating means 215) is acquired (step 222). The acquired billing information is sent to mobile phone 10. The mobile phone 10 displays the billing information on the display (step 231). The user can see the billing information. According to this captured image update operation, the captured image can be updated in a self-proliferating manner, and the work for maintaining the captured image can be significantly reduced.

E. Best Mode for Implementing the Proposed System

The proposed system can be implemented in many different forms. Therefore, it should not be interpreted only by the description of the embodiments below. In the embodiments, the system will be mainly described, but as will be apparent to those skilled in the art, the proposed system can be implemented as a program and method usable by a computer. Also, the proposed system can be implemented in hardware, software, or software and hardware embodiments.

The program can be recorded in any computer-readable medium such as a hard disk, a CD-ROM, a DVD-ROM, an optical storage device, or a magnetic storage device. Further, the program can be recorded on another computer via the network. Fig. 6 is a flowchart of the captured image request operation according to this embodiment.

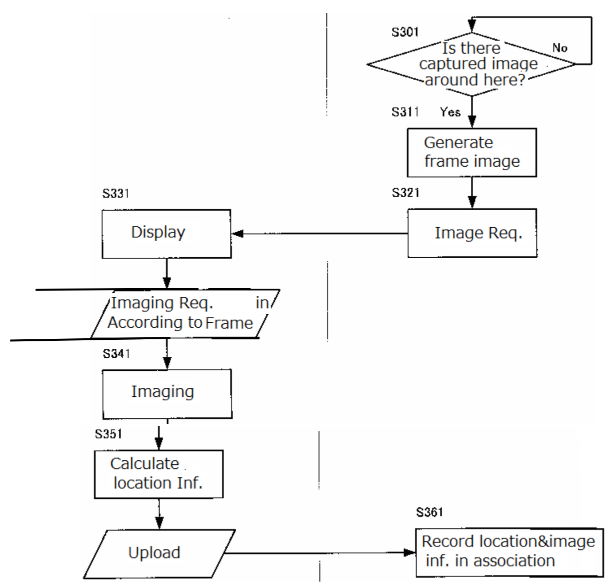

Fig. 6. Flowchart of the captured image request operation.

Even if at least one user can perform the captured image request operation when the 3D map information service is provided. Here, when no one is using the captured image requesting operation, the user who has registered by e-mail or the like, and the user who has used it can obtain the captured image request operation. Specifically, when it is acceptable to be the target user of the captured image requesting operation, a message requesting access to this URL is transmitted.

Server 20 (captured image requesting means 214) determines whether an image around the current position is stored in the captured image storage means 233 using the positioning information of the user who is in service (step 301). If it is stored, the process returns to step 301. If it is not stored, server 20 (captured image requesting means 214) generates a three-dimensional model that clearly shows the required frame of the building or the like from the three-dimensional map information around the current position (this is the wire frame itself. Or it may be one that has been subjected to hidden line treatment, or one that has been rented with a white outer surface. In addition, a convenience store, a store such as a gas station, or an intersection that will serve as a mark is clearly indicated. It may be configured), and the direction in which imaging is required is specified.

The server 20 sends the generated three-dimensional model and the positioning information of the imaging position to the mobile phone 10 as an imaging request.

The mobile phone 10 displays the three-dimensional model on the display (step 331), and the user gives an instruction to image in a designated direction in accordance with the frame. The mobile phone 10 performs imaging (step 341). The mobile phone 10 obtains positioning information at the time of imaging (step 351). The user uses the push button of the mobile phone 10 to select the upload of the captured image. The captured image and the positioning information are sent to server 20. The server 20 (captured image update means 213) updates the positioning information and the captured image in association with each other, as in step 211 (step 361). Steps 221 to 231 are also executed in this captured image requesting operation.

Since this captured image requesting operation is often carried out frequently during the 3D map information providing service, whether the captured image requesting operation may be performed for the user in the 3D map information providing service in advance. It is preferable to have a configuration that allows selection. According to this captured image, requesting operation, captured images required for the map information providing service can be efficiently collected.

When it is desired to collect mainly the picked-up images of a predetermined area in an urban area, it is possible to set to collect for such an area. Further, here, the trigger of the captured image request operation is separated only by the determination in step 301 of whether there is a captured image, but the target of the captured image request operation is even when a predetermined period has elapsed from the image capture date and time of the captured image.

It is also possible to always keep the latest image. Further, although the image capturing time is not specifically specified, the captured image is different depending on the image capturing time. It is also more preferable to carry out. Note that the server 20 side during the captured image request operation generated the three-dimensional model in which the frame is clearly defined, but the mobile phone 10 side during the captured image update operation generates the three-dimensional model in which the frame is clearly displayed using the three-dimensional map information. It can also be configured.

Although it is not mentioned about the processing here, which functions are to be implemented on the client side and which functions are to be implemented on the server side in a client-server system etc., are almost always changed within the scope of so-called design change by those skilled in the art to be able to.

F. Navigation Procedure

Fig. 7 is a flowchart of navigation operation according to this embodiment. The user presses the push button of the mobile phone 10 to select the navigation. The mobile phone prompts the user to specify the destination by using the same GUI as the in-vehicle navigation. The user sets the destination. The mobile phone 10 requests the positioning information (step 401). The mobile phone 10 sends the destination and the positioning information to the server 20. The server 20 (route searching means 217) searches for a route from the destination and the positioning information (step 411).

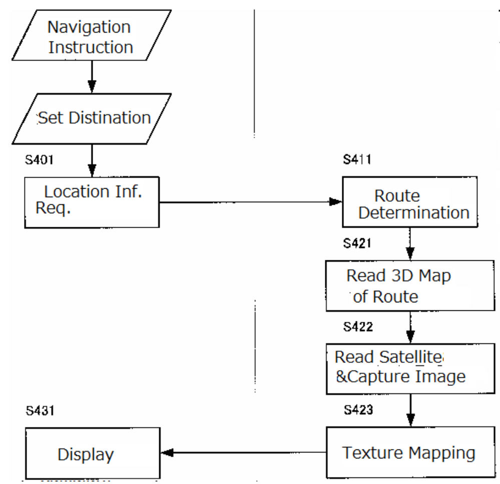

Fig. 7. Navigation procedure.

The route search is not an essential part of the proposed system, and a so-called person skilled in the art can apply a route search method that is already well known and will not be described in detail here. The server 20 (route searching means 217 and map information providing means 212) reads out the three-dimensional map information from the three-dimensional map information storage means 231 based on the route (step 421). The server 20 (the route searching means 217 and the map information providing means 212) reads the satellite image and the picked-up image from the satellite image storage means 232 and the picked-up image storage means 233 based on the route (step 422). The server 20 (route searching means 217 and map information providing means 212) attaches the satellite image and the captured image to the three-dimensional map information and further reveals the route (step 423). Revealing a route is generally a curve from the current position to the destination. The server 20 sends the three-dimensional map information to the mobile phone 10.

The mobile phone 10 displays three-dimensional map information on the display (step 431). The user can see a three-dimensional map around the current position or can see a three-dimensional map other than the current position on the route. Here, the three-dimensional map information on the route is collectively sent from the current position from the server 20 and displayed on the mobile phone 10, but the three-dimensional map is updated based on the update of the positioning information accompanying the user's movement or a predetermined time. Information can be sent out at any time. In addition, the billing update can be performed in the same manner as in steps 141 to 151.

Fig. 8 is a flowchart of the direction confirmation operation according to this embodiment. The user instructs the mobile phone 10 to take an image during the navigation operation. The mobile phone 10 carries out imaging (step 501). The bay 10 requests the positioning information by carrying (step 511). The user presses the push button of the mobile phone 10 and selects the function of confirming the direction. The mobile phone 10 sends the captured image and the positioning information to the server 20.

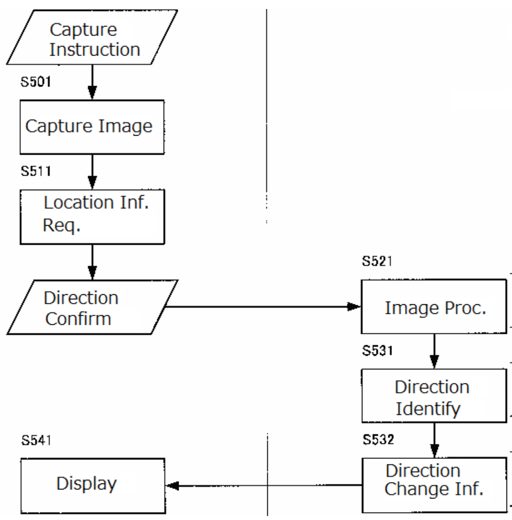

Fig. 8. Flowchart of the direction confirmation operation.

The server 20 performs image processing on the captured image to obtain an edge of a building or the like (step 521). Server 20 reads the three-dimensional map information from the three-dimensional map information storage unit 231 from the positioning information, compares the edges with the frame of the three-dimensional map information, and specifies the matching direction (step 531). The server 20 refers to the route of the three-dimensional map information for navigation sent to the user, identifies the correct direction on the route, and obtains direction change information from the direction identified in step 531 (step 532).

The direction change information includes a message for direction change, such as "How many times should the direction be changed clockwise from the current direction?" Several 20 sends the direction change information to the mobile phone 10. The mobile phone 10 displays direction change information on top of the currently displayed three-dimensional information for navigation (step 541). In addition, the billing update can be performed in the same manner as in steps 141 to 151.

According to this direction confirmation operation, the user visually compares the navigation with the image facing, as compared to the case where the user visually checks the navigation display and the image in the direction facing to reach the destination. No need. If the captured image is not mapped, and if no direction can be identified by the landscape of the same building, it points to an appropriate direction, which is highly convenient.

G. Navigation Procedure

The map information system according to the present embodiment is as follows: The map information system according to the present embodiment is configured in the same manner as the map information system according to the first embodiment, receives an image request from a certain user, and makes an image request to a user in an area satisfying the image request. This is different from the configuration in that the image requesting means for sending out the image and the steganography means for embedding the management identification information in the image are newly provided.

The steganography technique used in steganography is a well-known technique, and so-called persons skilled in the art can embed embedded information in a target image using various steganography techniques. Digital steganography technology can be used instead of steganography technology [15].

IV. Experiment

A. Direction Display

In each of the above-described embodiments, when the mobile phone 10 is displaying three-dimensional map information on the display, for example, when the direction key is pressed, the mobile phone 10 rotates in the assigned direction by the amount of the pressing. It can be configured to display. Specifically, when the front is displayed, by pressing the left direction key for a predetermined time, the landscape changes counterclockwise during the pressing time.

B. Three-Dimensional Album

In the map information system according to the second embodiment, during navigation, images and moving images captured by the user's mobile phone are sent to the server 20 at any time together with the positioning information, and the image for the navigational three-dimensional map information is displayed. Alternatively, the moving image may be embedded based on the positioning information and sent to the mobile phone 10 as a three-dimensional album.

C. Embedded Information for 3D Map Information

In the map information system according to the first embodiment, the user uploads the captured image in the captured image update operation and uses the uploaded captured image as an image to be attached to the three-dimensional model. Alternatively, for example, when a restaurant is specified, the captured image of the restaurant interior, the captured image of the food provided, and a description of the restaurant may be sent together with the positioning information, and the user can display the embedded information.

When requested, the three-dimensional map information including the embedded information may be displayed. Furthermore, if you create a site that displays only embedded information for each genre in a menu format and the user who accesses the site selects "3D map information", various services for 3D map information of this system will be provided. It can also be configured too.

V. Conclusion

A pedestrian navigation system with a 3D map and a charging server based on steganography is proposed. The server system, which provides topographic maps and navigation information for pedestrians as well as automobiles, is proposed. Required images of cross sections, intersections, or points of interest can be automatically acquired from users when they use the proposed system. Users get beneficial points when they submit photos acquired with their mobile phone camera, so that they intend to submit. If the quality of the image is better than previously archived image, then the new image is overwritten over the previous one. Steganography is featured for security reasons in the charging system for the use of the system.

Although the presently proposed system has been described by the above respective embodiments, the technical scope of the presently proposed system is not limited to the scope described in the embodiments, and various changes or improvements can be added to these respective embodiments. The embodiment with such changes or improvements is also included in the technical scope of the proposed system.

Future Research Works

Further experiments are required for validation of the proposed method and system in actual situations. Research is underway in automated collection and updating of real-time barrier information using smartphone sensors and AI technology. Real-time direction estimation using deep learning and image-based correction algorithms is also evolving. Infrastructure-free navigation technologies, such as high-precision autonomous positioning methods using shoe-mounted inertial sensors, are gaining attention.

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