

[DESCRIPTION]

[Title of Invention]

INFORMATION PROCESSING SYSTEM, INFORMATION PROCESSING METHOD,
AND COMPUTER PROGRAM PRODUCT

[Technical Field]

[0001]

The present disclosure relates to an information processing system, an information processing method, and a computer program product.

[Background Art]

[0002]

Recent laser scanners and Light Detection and Ranging (LiDAR) systems acquire three-dimensional (3D) information of a 3D space which is a physical space. With reference to digital data of space information, which is an example of such 3D information, a situation of a site is grasped at a place other than the site. Such digital data is also utilized in association with existing management information.

[0003]

PTL 1 discloses a method as follows. A visibility score is computed for each of digital objects of a digital object pair, based on a position of the digital object relative to a position and an orientation of a virtual camera. A polygon mesh (3D information) associated with a digital object with a highest visibility score is downloaded based on the polygon mesh being absent. The polygon mesh of the digital object with the highest visibility score is rendered and displayed on a display device.

PTL 1, however, does not take into account that 3D information a user wishes to preferentially acquire varies from user to user.

[Citation List]

[Patent Literature]

[0004]

[PTL 1]

Japanese Patent No. 7189288

[Summary of Invention]

[Technical Problem]

[0005]

In view of the foregoing, the present disclosure provides a technique of preferentially acquiring 3D information desired by a user more.

[Solution to Problem]

[0006]

According to an embodiment of the present disclosure, an information processing system includes a storage device, an acquisition unit, a display control unit, and a reception unit. The storage device stores a 3D information group including a plurality of 3D information items.

The acquisition unit acquires the 3D information group from the storage device. The display control unit displays, on a display, the plurality of 3D information items according to a priority that is predetermined. The reception unit receives attribute information of a user. The display control unit causes the plurality of 3D information items to be displayed according to a first priority in a case where the reception unit receives first attribute information, and causes the plurality of 3D information items to be displayed according to a second priority different from the first priority in a case where the reception unit receives second attribute information different from the first attribute information.

According to an embodiment of the present disclosure, an information processing system includes a storage device, an acquisition unit, a display control unit, and a display history extraction unit. The storage device stores a 3D information group including a plurality of 3D information items. The acquisition unit acquires the 3D information group from the storage device. The display control unit displays, on a display, the plurality of 3D information items according to a priority that is predetermined. The display history extraction unit extracts a display history indicating a history of a 3D information item, among the plurality of 3D information items, or another 3D information item that has been displayed. The display control unit causes the 3D information item to be displayed according to a first priority in a case where the display history extraction unit extracts a first display history, and causes the plurality of 3D information items to be displayed according to a second priority different from the first priority in a case where the display history extraction unit extracts a second display history different from the first display history.

According to an embodiment of the present disclosure, an information processing method includes acquiring a 3D information group including a plurality of 3D information items from a storage device that stores the 3D information group; displaying, on a display, the plurality of 3D information items according to a priority that is predetermined; and receiving attribute information of a user. The displaying includes displaying the plurality of 3D information items according to a first priority in a case where first attribute information is received in the receiving, and displaying the plurality of 3D information items according to a second priority different from the first priority in a case where second attribute information different from the first attribute information is received in the receiving.

According to an embodiment of the present disclosure, a computer program product includes instructions which, when executed by a computer, cause the computer to carry out a method including acquiring a 3D information group including a plurality of 3D information items; displaying, on a display, the plurality of 3D information items according to a priority that is predetermined; and receiving attribute information of a user. The displaying includes displaying the plurality of 3D information items according to a first priority in a case where first attribute information is received in the receiving, and displaying the plurality of 3D information items according to a second priority different from the first priority in a case

where second attribute information different from the first attribute information is received in the receiving.

According to an embodiment of the present disclosure, a computer program product includes instructions which, when executed by a computer, cause the computer to carry out a method including acquiring a 3D information group including a plurality of 3D information items; setting a priority in accordance with which the plurality of 3D information items are to be output; and outputting the plurality of 3D information items according to the set priority. The setting includes at least one of receiving attribute information of a user, and extracting a display history indicating a history of a 3D information item, among the plurality of 3D information items, or another 3D information item that has been displayed. The priority is set based on at least one of the attribute information and the display history.

[Advantageous Effects of Invention]

[0007]

The technique of the present disclosure allows 3D information desired by a user to be preferentially acquired.

[Brief Description of Drawings]

[0008]

A more complete appreciation of embodiments of the present disclosure and many of the attendant advantages and features thereof can be readily obtained and understood from the following detailed description with reference to the accompanying drawings.

[FIG. 1]

FIG. 1 is a diagram illustrating an example of a hardware configuration of an information processing system according to a first embodiment of the present disclosure.

[FIG. 2]

FIG. 2 is a diagram illustrating an example of a 3D information list.

[FIG. 3]

FIG. 3 is a diagram illustrating an example of an overhead view of a component displayed on a display device.

[FIG. 4]

FIG. 4 is a diagram illustrating an example of a given-viewpoint view of a component displayed on the display device.

[FIG. 5]

FIG. 5 is a diagram illustrating an example of a functional configuration of a control device.

[FIG. 6A]

FIG. 6A is a diagram illustrating an example of a format of attribute information of users.

[FIG. 6B]

FIG. 6B is a diagram illustrating an example of a format of additional information of components.

[FIG. 7]

FIG. 7 is a flowchart illustrating an example of a processing procedure in the first embodiment of the present disclosure.

[FIG. 8]

FIG. 8 is a diagram illustrating an example of statistical information.

[FIG. 9]

FIG. 9 is a diagram illustrating an example of a functional configuration of a priority setting unit according to a second embodiment of the present disclosure.

[FIG. 10]

FIG. 10 is a flowchart illustrating an example of a processing procedure in the second embodiment of the present disclosure.

[FIG. 11]

FIG. 11 is a schematic diagram illustrating an example of an information processing system according to a third embodiment of the present disclosure.

[FIG. 12]

FIG. 12 is a diagram illustrating an example of a hardware configuration of an information processing apparatus and a server apparatus according to the third embodiment of the present disclosure.

The accompanying drawings are intended to depict embodiments of the present disclosure and should not be interpreted to limit the scope thereof. The accompanying drawings are not to be considered as drawn to scale unless explicitly noted. Also, identical or similar reference numerals designate identical or similar components throughout the several views.

[Description of Embodiments]

[0009]

In describing embodiments illustrated in the drawings, specific terminology is employed for the sake of clarity. However, the disclosure of this specification is not intended to be limited to the specific terminology so selected and it is to be understood that each specific element includes all technical equivalents that have a similar function, operate in a similar manner, and achieve a similar result.

Referring now to the drawings, embodiments of the present disclosure are described below.

As used herein, the singular forms "a," "an," and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise.

An information processing system, an information processing method, and a program according to embodiments of the present disclosure will be described in detail below with reference to the accompanying drawings.

[0010]

First Embodiment

FIG. 1 is a diagram illustrating an example of a hardware configuration of an information processing system 1 according to a first embodiment of the present disclosure.

[0011]

The information processing system 1 includes an information processing apparatus 10 and a storage device 11. The information processing apparatus 10 and the storage device 11 are communicably connected to each other.

[0012]

The storage device 11 accumulates 3D information of a 3D space which is a physical space. The storage device 11 is, for example, a database. The 3D information is, for example, information acquired by a camera such as a Time-of-Flight (ToF) camera or a stereo camera. In the ToF method, an object to be measured is irradiated with infrared light. A distance to the object is calculated based on a time from when the infrared light is emitted toward the object to when reflected light from the object returns. The stereo camera, with two cameras, obtains depth information as distance information, based on an interval between the two cameras and parallax information of images respectively obtained by the two cameras. Note that the 3D information may be obtained using another method, for example, by a system or the like using LiDAR or photogrammetry.

[0013]

The 3D information represents a 3D space which is a physical space. The file format of the 3D information is not limited. The 3D information is represented by, for example, shape data representing a 3D shape of a 3D object included in the physical space. The 3D information is, for example, a file in a point cloud format that represents a 3D space by discrete points, or a file in a polygon mesh format representing a 3D space by vertices and surfaces. The file in the point cloud format may be referred to as, for example, a depth map or a distance image.

[0014]

Examples of files in the point cloud format include files represented with extensions such as ".xyz", ".e57", and ".ply". Examples of files in the polygon mesh format may include files represented with extensions such as ".obj", ".fbx", and ".stl".

[0015]

The storage device 11 outputs the 3D information accumulated therein to the information processing apparatus 10.

[0016]

The information processing apparatus 10 displays a two-dimensional (2D) image, which is a view of a 3D space represented by the 3D information from a virtual viewpoint of a virtual camera. The information processing apparatus 10 is, for example, a smartphone, a tablet terminal, or a personal computer (PC).

[0017]

The information processing apparatus 10 includes a communication device 12, a user interface (UI) device 14, a control device 20, a read-only memory (ROM) 22, a random access memory (RAM) 24, and a hard disk drive (HDD) 26. These devices are communicably connected to one another through a bus 30.

[0018]

The communication device 12 communicates with an external apparatus via a network, for example. In the present embodiment, the communication device 12 communicates with the storage device 11.

[0019]

The UI device 14 includes a display device 14A and an input device 14B. The display device 14A displays various types of information. The input device 14B receives an operation instruction and input data from a user. The user inputs, for example, identification such as a user ID and information (such as a building name) related to 3D information to be displayed. The input device 14B is, for example, a keyboard or a pointing device such as a mouse. The display device 14A and the input device 14B may be combined into a single device, such as a touch panel.

[0020]

The ROM 22, the RAM 24, and the HDD 26 are storage devices of the information processing apparatus 10 that store various types of information. The 3D information output from the storage device 11 may be stored in these storage devices. Note that a solid state drive (SSD) may be used as the storage device of the information processing apparatus 10.

[0021]

As described below, the control device 20 controls processing for preferentially displaying 3D information desired by a user more. For example, an operation of the control device 20 may be implemented by one or more processors. For example, the operation of the control device 20 may be implemented by execution of a program by a processor such as a central processing unit (CPU), that is, by software. Each of the above-described devices may be implemented by a processor such as a dedicated integrated circuit (IC), that is, by hardware. Alternatively, each of the above-described devices may be implemented by software and hardware in combination. When two or more processors are used, each processor may implement one of the above-described devices or two or more of the above-described devices.

[0022]

FIG. 2 is a diagram illustrating an example of a 3D information list. A user selects a desired place from the list illustrated in FIG. 2 to display the selected place on the display device 14A via a display application such as a viewer. In this example, 3D information to be displayed is information of a space such as a structure (e.g., a building) including a plurality of floors. Information of each of components (such as floors, rooms, and areas) of the structure is stored as a 3D information item in the storage device 11. A structure such as a building is an example of a space including a plurality of components. A collection of 3D information items of the plurality of components (a set of 3D information items) is referred to as a 3D information group. For example, a collection of 3D information items that correspond to respective rooms and respective areas is a 3D information group. This 3D information group is a set of 3D information items that corresponds to the entire building. The 3D information group may have a hierarchical configuration. For example, a set of 3D information items of a plurality of

rooms and areas may form a 3D information group corresponding to one floor. Sets of 3D information items for a plurality of floors may form a 3D information group corresponding to one structure.

[0023]

The display application operates on a PC or a mobile terminal such as a smartphone or a tablet terminal, and may be an application installed and used alone or a web application used via a web browser. In the 3D information list, names of individual components of a space are hierarchically represented. In FIG. 2, "2F Office Floor" is selected, then "Tenant space" and "Restroom" at a level below are selected, and names of areas at a level further below are displayed. The user operates the input device 14B to select a component such as a room or area the user wishes to view from such a list and cause the display device 14A to display the 3D information item of the selected component.

[0024]

FIG. 3 is a diagram illustrating an example of an overhead view of a component displayed on the display device 14A. FIG. 4 is a diagram illustrating an example of a given-viewpoint view of a component displayed on the display device 14A. The user can view the 3D information item of the selected component while switching the display between the overhead view and the given-viewpoint view in this manner. The user operates the input device 14B to change the angle of the overhead view and the viewpoint of the given-viewpoint view, and thus can check the details of the component at various angles and from various viewpoints.

[0025]

Due to a vast data amount of the 3D information items, the information processing apparatus 10 may take some time to acquire all the data to be displayed. When a user selects a component the user wishes to view during data acquisition, a waiting time may occur until the display starts, because the acquisition of data of the selected component has not been completed yet.

[0026]

In the present embodiment, priorities are set for 3D information items in accordance with an attribute of a user, and the 3D information items are acquired in descending order of the priorities. FIG. 5 is a diagram illustrating an example of a functional configuration of the control device 20.

The control device 20 includes a reception unit 20A, a priority setting unit 20B, an acquisition unit 20C, a display data generation unit 20D, and a display control unit 20E.

[0027]

The reception unit 20A receives an operation instruction and input data from a user via the input device 14B.

[0028]

The priority setting unit 20B uses a method described below to set priorities to 3D information items to be displayed.

[0029]

The acquisition unit 20C acquires the 3D information items, based on the priority set by the priority setting unit 20B. The acquisition unit 20C acquires the 3D information items from the storage device 11 via the communication device 12. The acquisition unit 20C may acquire the 3D information items from another device communicably connected to the information processing apparatus 10 via the communication device 12 and a network. For example, the other device is, but not limited to, a smartphone that acquires the 3D information items. The acquisition unit 20C may acquire the 3D information items from the storage device of the information processing apparatus 10.

[0030]

The 3D information items acquired by the acquisition unit 20C may be either monochrome information items or color information items including color information. The information processing apparatus 10 uses such a color information item as the 3D information item to convert the 3D information item into a 2D image for display. Thus, the information processing apparatus 10 provides the user with the 2D image that is easier to understand visually.

[0031]

The acquisition unit 20C outputs the acquired 3D information items to the display data generation unit 20D. The acquisition unit 20C may convert the 3D information items acquired from the storage device 11 into information in any file format, and output the information to the display data generation unit 20D. For example, the acquisition unit 20C may use a method disclosed in Japanese Unexamined Patent Application Publication No. 2019-049533 to convert a file (3D information) in a point cloud format into a file in a polygon mesh format, and output the converted 3D information to the display data generation unit 20D. This file format conversion processing may be performed by the display data generation unit 20D.

[0032]

The display data generation unit 20D converts the 3D information items into 2D information items for display. The display control unit 20E displays, on the display device 14A, the 2D information items generated by the display data generation unit 20D. As described above, the acquisition unit 20C acquires the 3D information items, based on the priorities. Thus, the display control unit 20E displays, on the display device 14A, the 2D information items converted from the 3D information items, based on the priorities.

[0033]

The priority setting unit 20B includes an attribute information extraction unit 201, an additional information extraction unit 202, and a priority calculation unit 203.

[0034]

The attribute information extraction unit 201 extracts attribute information of a user from input data of the user received by the reception unit 20A. The attribute information indicates

an occupation, a duty, an age, a position, a duration of service, or the like of the user, and includes one or more of these elements.

[0035]

The additional information extraction unit 202 extracts additional information assigned to each component from the extracted data of the list. The additional information indicates a configuration, an area, a height, the number of tenants, the number of rooms, a role, a purpose, or the like of a space such as a building and components, and includes one or more of these elements.

[0036]

The priority calculation unit 203 calculates a priority of each component, based on the extracted attribute information and additional information. For example, when the attribute information indicates that the user's duty is equipment management, a high priority is calculated for components (such as a machine room, an electrical room, a boiler room, an air conditioner room, and a communication room) assigned additional information indicating a relation to the equipment.

[0037]

FIG. 6A is a diagram illustrating an example of a format of the attribute information of users. FIG. 6B is a diagram illustrating an example of a format of the additional information of components. In the format illustrated in FIG. 6A, a user ID is information that allows the information processing apparatus 10 to identify each user. For each user ID, attribute information is set. The attribute information is recorded in the storage device of the information processing apparatus 10 and is extracted by the attribute information extraction unit 201 when a user starts viewing 3D information items. Note that the attribute information extraction unit 201 may use information other than the user ID to extract the attribute information. For example, when the user starts viewing, the display device 14A may display an attribute information selection screen to allow the user to select attribute information or the display device 14A may display a selection screen of a viewing purpose (such as "for equipment management") associated with the attribute information. In this way, the attribute information extraction unit 201 may extract the attribute information.

[0038]

In the format illustrated in FIG. 6B, a component ID is information that allows the information processing apparatus 10 to identify each component. For each component ID, additional information is set. The additional information is recorded in the storage device of the information processing apparatus 10 and is extracted by the additional information extraction unit 202 when the priority calculation unit 203 calculates the priority.

[0039]

The attribute information and the additional information may be represented by numerical values or symbols or by words such as "equipment manager" and "machine room". When the attribute information is set for each user ID, some fields of the attribute information may not

be set. Likewise, some fields of the additional information for each component ID may not be set. For example, the field "position" may not be set for the user ID of a user who does not have the position. The fields "the number of tenants" and "the number of rooms" may not be set for the component ID of a room.

[0040]

The priority calculation unit 203 calculates the priority, based on a relevance between the attribute information and the additional information. For example, the priority calculation unit 203 calculates a high priority for a component assigned more additional information of a high relevance. The relevance between the attribute information and the additional information may be automatically generated based on a predetermined algorithm, or manually generated by an administrator or the like of an organization to which the user belongs. When the relevance is manually generated by the administrator or the like, a status specific to the user is reflected in the relevance.

[0041]

The relevance between the attribute information and the additional information may be set in a table format. For example, a relevance table is set in which the attribute information related to the duty is arranged in fields in a horizontal direction and the additional information related to the purpose is arranged in fields in a vertical direction. In such a table, a high relevance is set for a combination of the attribute information "equipment management" and the additional information such as "machine management" or "electrical management", and a low relevance is set for a combination of the attribute information "equipment management" and the additional information such as "for office" or "for experiment".

[0042]

The relevance between the attribute information and the additional information may be determined based on an artificial intelligence (AI) algorithm trained by machine learning. Machine learning is a technology that allows a computer to acquire a human-like learning ability. Machine learning refers to a technology in which a computer autonomously generates an algorithm for determination such as data identification from learning data loaded in advance and applies the generated algorithm to new data to make a prediction. For example, an AI algorithm is trained, by machine learning, in advance by using a plurality of sets of attribute information and additional information as input data and pieces of relevance data for the respective sets as output data. The relevance is determined using such an AI algorithm.

[0043]

In this manner, the priority setting unit 20B sets the priority for each component in accordance with the attribute information of the user. Thus, a priority (first priority) set in a case where the reception unit 20A receives first attribute information may differ from a priority (second priority) set in a case where the reception unit 20A receives second attribute information different from the first attribute information. For example, when the first attribute information indicates the "equipment manager", the first priority is such that priorities for equipment-

related components such as the machine room and the electrical room are high. In contrast, when the second attribute information indicates the "engineer", the second priority is such that priorities for technology-development-related components such as a research room and a laboratory are high. Thus, the second priority differs from the first priority. The acquisition unit 20C then acquires a 3D information item, based on the priority. The display control unit 20E displays, on the display device 14A, a 2D information item converted from the 3D information item, based on the priority. Thus, the 3D information item the user wishes to view is efficiently acquired and displayed without any waiting time.

[0044]

FIG. 7 is a flowchart illustrating an example of a processing procedure in the first embodiment of the present disclosure. In step S10, the reception unit 20A receives attribute information of a user via the input device 14B. In step S11, the reception unit 20A identifies a 3D information group to be displayed, in accordance with an operation input of the user. The 3D information group to be displayed is identified based on a file name, a Uniform Resource Locator (URL), or the like.

[0045]

In step S12, the attribute information extraction unit 201 extracts the received attribute information. In step S13, the additional information extraction unit 202 extracts additional information of the identified 3D information group. In step S14, the priority calculation unit 203 calculates a priority for each component included in the identified 3D information group, based on the extracted attribute information and additional information.

[0046]

In step S15, the acquisition unit 20C and the display control unit 20E acquire and display the 3D information item in accordance with the set priority, respectively. For example, the display control unit 20E displays a component with a high priority on the display device 14A when acquisition of the component is completed, so that the component with the high priority is preferentially displayed. Each time acquisition of components with a high priority is completed, the display control unit 20E may display the names of the displayable components, and display a 3D information item of a component selected by the user by the name from among the displayed names.

[0047]

The 3D information item may include two types of data, i.e., high-quality data (high-quality 3D information item) having a high resolution and a large data size and thumbnail data (low-quality 3D information item) having a low resolution and a small data size. These pieces of data are usually used in a method in which all pieces of thumbnail data are acquired first, the user selects a place (component) to be viewed using a piece of thumbnail data, and high-quality data of the selected component is acquired. In the present embodiment, the priority is set based on the attribute information of the user, and the 3D information items are displayed in accordance with the priority. Thus, the component the user wishes to view is more quickly

displayed. In an example, all the pieces of thumbnail data are acquired and the overview of the 3D information items is displayed. Then, the high-quality data is displayed in accordance with the set priority. In the acquisition of the pieces of thumbnail data, the pieces of thumbnail data may be acquired and displayed in accordance with the priority. In this manner, the thumbnail data of a place the user wishes to view is quickly displayed. This allows the user to check the component the user wishes to view before the display of all the pieces of thumbnail data is completed. In this case, when the user selects a component the user wishes to view before the display of all the pieces of thumbnail data is completed, high-quality data of the selected component is displayed. Thus, high-quality data of the component the user wishes to view is more quickly displayed. In another example, the thumbnail data and the high-quality data may be acquired and displayed in parallel. The high-quality data is displayed for a component with a high priority (an example of a first component) from the beginning, and the thumbnail data is displayed for a component with a low priority (an example of a second component). In this manner, the component the user wishes to view is displayed at a high quality while the overview of the 3D information items is quickly displayed. Alternatively, the high-quality data of the component with a high priority and the thumbnail data of the component with a low priority may be displayed in a first step. Then, the high-quality data of the component with the low quality may be acquired and displayed in a second step.

[0048]

Note that when the 3D information items described above are associated with other pieces of data (such as document information such as a memo, metadata, and image information), these other pieces of data may be acquired and displayed in accordance with the priority.

[0049]

The program executed by the control device 20 may be preinstalled on the ROM 22 or the like and provided. The program may be recorded as a file in an installable or executable format on a computer-readable recording medium such as a compact disc read-only memory (CD-ROM), a flexible disk (FD), a compact disc recordable (CD-R), or a digital versatile disc (DVD) and may be provided as a computer program product. The program may be stored in a computer connected to a network such as the Internet, and downloaded and thus provided via the network. The program may be provided or distributed via the network such as the Internet. The program may cause the computer to function as the individual units of the apparatus or device described above. The CPU of the computer reads the program from the computer-readable storage medium to a main storage device, and executes the program. The apparatus or device described above may be implemented as a virtual machine that operates on a cloud system.

[0050]

In the embodiment described above, 3D information items are acquired and displayed in accordance with a priority that is based on attribute information of a user. Thus, the 3D information item desired by the user more is preferentially displayed.

[0051]

Second Embodiment

A second embodiment of the present disclosure will be described.

[0052]

The present embodiment differs from the first embodiment in that the priority described above is set based on statistical information indicating a relationship between a priority and a display history indicating a history of 3D information items that have been displayed by a user or based on an AI algorithm trained, by machine learning, on this relationship. In the description of the present embodiment below, description of the same portion as the first embodiment is omitted and differences from the first embodiment will be described.

[0053]

In the present embodiment, to acquire the statistical information, for example, information such as which component is displayed next with a high frequency after a certain component is displayed is collected from a record of the 3D information items, viewed by the user, of components included in a building A. For each display history (information indicating the component displayed immediately before), a probability of each component being displayed is acquired as the statistical information. FIG. 8 is a diagram illustrating an example of the statistical information. In FIG. 8, a table in which the display history is arranged in fields in a horizontal direction and components to be displayed next are arranged in fields in a vertical direction is generated as the statistical information. The table presents a probability of each component being displayed after a component indicated by the display history is displayed. For example, the probabilities of an area B, a room A, and a room B being displayed after an area A is displayed are 40%, 5%, and 2%, respectively. In this case, the priority set after the room A is displayed is in an order of "... , area B, ... , room A, ... , room B, ..." (in portions represented by "...", other components may be present).

[0054]

The display history may indicate a component other than the previously displayed component (displayed immediately before). For example, the display history may indicate a set of components from the component displayed n times before (where n is an integer of 2 or greater) to the component displayed immediately before. In such a case, for each display history, a probability of each component being displayed next is acquired as the statistical information. When the priority is set based on the AI algorithm, the AI algorithm is trained, by machine learning, in advance by using a plurality of display histories as input data and data of the priority ranks corresponding to the respective display histories as output data.

[0055]

FIG. 9 is a diagram illustrating an example of a functional configuration of the priority setting unit 20B. The priority setting unit 20B includes a display history extraction unit 213 and the priority calculation unit 203. The display history extraction unit 213 extracts a display history

of a component displayed by the user, from the storage device of the information processing apparatus 10.

[0056]

The priority calculation unit 203 calculates the priority of each component, based on the extracted display history and the above-described statistical information or AI algorithm.

[0057]

The priority setting unit 20B sets the priority of each component in accordance with the display history in this manner. Thus, a priority (first priority) set after a first display history may differ from a priority (second priority) set after a second display history different from the first display history. For example, when the statistical information illustrated in FIG. 8 is used and the first display history indicates that the area A is displayed, the calculated priority is in an order of "... , area B, ... , room A, ... , room B, ...". In contrast, when the second display history indicates that the area B is displayed, the calculated priority is in an order of "... , area A, ... , room B, ... , room A, ...". The acquisition unit 20C then acquires the 3D information item, based on the priority. The display control unit 20E displays, on the display device 14A, the 2D information item converted from the 3D information item, based on the priority. Thus, the 3D information item highly likely to be viewed next is efficiently acquired and displayed to a user with known attribute information without any waiting time.

[0058]

FIG. 10 is a flowchart illustrating an example of a processing procedure in the second embodiment of the present disclosure. Since processing other than steps S21 and S22 is the same as that of the first embodiment, detailed description thereof is omitted.

In step S20, the reception unit 20A identifies a 3D information group to be displayed, in accordance with an operation input of the user.

[0059]

In step S21, after the user displays one or more components to be displayed, the display history extraction unit 213 extracts a corresponding display history from the display device of the information processing apparatus 10. In step S22, the priority calculation unit 203 calculates a priority for each component included in the identified 3D information group, based on the extracted display history and the above-described statistical information or AI algorithm.

[0060]

In step S23, the acquisition unit 20C and the display control unit 20E acquire and display the 3D information item in accordance with the set priority, respectively.

[0061]

When the statistical information or the AI algorithm is created based on data of actual operation results, the created statistical information or AI algorithm may have an insufficient accuracy in a period with a small number of operation results. In such a case, the priority setting unit 20B may set the priority, for example, by setting a high priority for a component

physically close to the component included in the display history or by setting a high priority for a component having the same or similar additional information as or to the additional information of the component included in the display history.

[0062]

Even when the number of operation results is small for a 3D information group of a certain building, if the statistical information or AI algorithm is created for another building, the component is efficiently displayed. For example, similarities between the display-target building and other buildings are calculated using additional information of the display-target building and additional information of the other buildings, and the statistical information or AI algorithm created for a building (similar building) similar to the display-target building is used. The similarity between a component of the display-target building and a component of the similar building is calculated using additional information of the components. For example, suppose that the statistical information or AI algorithm is created for a similar building A' of a building A with a small number of operation results. In this case, suppose that a', b', c', ... denote components of the building A' similar to components a, b, c, ... of the building A, respectively. Then, the priorities set for the components a', b', c', ... of the building A' are respectively reflected in the priorities for the components a, b, c, ... of the building A using a similarity relationship between the components. This allows the priority to be set for a display target with a small number of operation results in accordance with the display history.

[0063]

In the present embodiment, the 3D information item is acquired and displayed in accordance with the priority based on the display history of the 3D information item that has been displayed by the user or the priority based on the display history of another 3D information item, different from the 3D information item desired by the user, that has been displayed. In this manner, the 3D information item desired by the user more is preferentially displayed.

[0064]

Note that the priority setting unit 20B may further include the attribute information extraction unit 201 and the additional information extraction unit 202 described in the first embodiment, and the priority calculation unit 203 may calculate the priority based on at least one of the attribute information and the display history. Thus, for example, through adaptive processing such as using the display history for a user with unknown attribute information and using attribute information when the display history is not accumulated, the 3D information item is efficiently acquired.

[0065]

Third Embodiment

A third embodiment of the present disclosure will be described.

[0066]

In the present embodiment, the information processing system 1 described above is implemented by a hardware configuration different from those of the first and second

embodiments. In the description of the present embodiment below, description of the same portion as the first and second embodiments is omitted and differences from the first and second embodiments will be described.

[0067]

In the first and second embodiments, the example of the information processing apparatus 10 having the functions of the reception unit 20A, the priority setting unit 20B, the acquisition unit 20C, the display data generation unit 20D, and the display control unit 20E has been described. However, at least one function included in the information processing apparatus 10 may be included in an external apparatus connected to via a network.

[0068]

FIG. 11 is a schematic diagram illustrating an example of an information processing system 1B according to the third embodiment of the present disclosure.

[0069]

The information processing system 1B includes the storage device 11, an information processing apparatus 10A, and a server apparatus 10B. The storage device 11, the information processing apparatus 10A, and the server apparatus 10B are communicably connected to one another via a network NW.

[0070]

The information processing apparatus 10A displays a 2D image, which is a view of a 3D space represented by 3D information from a virtual viewpoint of a virtual camera, and is, for example, a smartphone, a tablet terminal, or a personal computer. The information processing apparatus 10A includes the communication device 12, the UI device 14, and a control device 21. The communication device 12, the UI device 14, and the control device 21 are communicably connected to one another. The control device 21 includes the reception unit 20A, the acquisition unit 20C, the display data generation unit 20D, and the display control unit 20E. The storage device 11, the communication device 12, the UI device 14, the reception unit 20A, the acquisition unit 20C, the display data generation unit 20D, and the display control unit 20E are the same as or similar to those of the first and second embodiments. The communication device 12 outputs input data of a user received by the reception unit 20A, to the server apparatus 10B.

[0071]

The server apparatus 10B includes a communication device 13 and a control device 23. The communication device 13 communicates with the information processing apparatus 10A and the storage device 11 via the network NW. The control device 23 includes the priority setting unit 20B. The priority setting unit 20B is the same as or similar to that of the first and second embodiments. The communication device 13 outputs 3D information items in an order based on the set priority, to the information processing apparatus 10A. This allows the information processing apparatus 10A to display the 3D information items in accordance with the set priority. When the priority setting unit 20B includes the attribute information extraction unit

201 and the additional information extraction unit 202, the communication device 13 extracts attribute information of a user from input data of the user received from the information processing apparatus 10A. When the priority setting unit 20B includes the display history extraction unit 213, the display history may be stored in the storage device 11 or the like. Note that the acquisition unit 20C may acquire the 3D information items from the storage device 11 via the server apparatus 10B, or may acquire the 3D information items directly from the storage device 11 based on authentication performed by the server apparatus 10B.

[0072]

As illustrated in FIG. 11, at least one of the functions of the information processing apparatus 10 may be included in the server apparatus 10B.

[0073]

A hardware configuration of the information processing apparatus 10A and the server apparatus 10B will be described.

[0074]

FIG. 12 is a diagram illustrating an example of a hardware configuration of the information processing apparatus 10A and the server apparatus 10B.

[0075]

The information processing apparatus 10A and the server apparatus 10B each include a control device such as a CPU 90A, a storage device such as a ROM 90B and a RAM 90C, an I/F 90D that establishes a connection to a network and performs communication, an HDD 90E, and a bus 90F that connects these devices to one another.

[0076]

A program to be executed by each of the information processing apparatus 10A and the server apparatus 10B is preinstalled on the ROM 90B or the like and provided.

[0077]

The program to be executed by each of the information processing apparatus 10A and the server apparatus 10B may be recorded as a file in an installable or executable format on a computer-readable recording medium such as a CD-ROM, a flexible disk, a CD-R, or a DVD and may be provided as a computer program product.

[0078]

The program to be executed by each of the information processing apparatus 10A and the server apparatus 10B may be stored in a computer connected to a network such as the Internet, and downloaded and thus provided via the network. The program to be executed by each of the information processing apparatus 10A and the server apparatus 10B may be provided or distributed via a network such as the Internet.

[0079]

The program to be executed by each of the information processing apparatus 10A and the server apparatus 10B may cause a computer to function as the individual units of the information processing apparatus 10A or the server apparatus 10B. The CPU 90A of the

computer reads the program from the computer-readable storage medium to a main storage device, and executes the program.

[0080]

The information processing apparatus 10A and the server apparatus 10B each may be implemented as a virtual machine that operates on a cloud system.

[0081]

Although some embodiments of the present disclosure have been described above, the first to third embodiments are presented as examples and are not intended to limit the scope of the present disclosure. Such novel embodiments may be carried out in various other forms.

Various omissions, substitutions, and changes may be made without departing from the gist of the present disclosure. Such embodiments are within the scope and gist of this disclosure and are also within the scope of the appended claims and the equivalent scope.

[0082]

The aspects of the present disclosure are as follows, for example.

According to Aspect 1, an information processing system includes a storage device, an acquisition unit, a display control unit, and a reception unit. The storage device stores a 3D information group including a plurality of 3D information items. The acquisition unit acquires the 3D information group from the storage device. The display control unit causes the plurality of 3D information items to be displayed in accordance with a priority that is predetermined. The reception unit receives attribute information of a user. The display control unit causes the plurality of 3D information items to be displayed in accordance with a first priority in a case where the reception unit receives first attribute information, and causes the plurality of 3D information items to be displayed in accordance with a second priority different from the first priority in a case where the reception unit receives second attribute information different from the first attribute information.

According to Aspect 2, in the information processing system of Aspect 1, the priority is set based on the attribute information and additional information related to the plurality of 3D information items.

According to Aspect 3, in the information processing system of Aspect 2, the plurality of 3D information items include 3D information items of a plurality of components included in a space, and the additional information includes at least one of a configuration, an area, a height, a number of tenants, a number of rooms, a role, and a purpose of the space and the plurality of components.

According to Aspect 4, in the information processing system of any one of Aspects 1 to 3, the attribute information includes at least one of an occupation, a duty, an age, a position, and a duration of service of the user.

According to Aspect 5, the information processing system of any one of Aspects 1 to 4 further includes a priority setting unit. The priority setting unit sets the priority. The acquisition unit

acquires the plurality of 3D information items of the 3D information group in accordance with the priority set by the priority setting unit.

According to Aspect 6, in the information processing system of any one of Aspects 1 to 5, the plurality of 3D information items include a plurality of high-quality 3D information items, and a plurality of low-quality 3D information items. The priority is a priority of the high-quality 3D information items.

According to Aspect 7, in the information processing system of any one of Aspects 1 to 5, the plurality of 3D information items include a plurality of high-quality 3D information items and a plurality of low-quality 3D information items, and the priority of the high-quality 3D information items are higher than the priority of the low-quality 3D information items.

According to Aspect 8, an information processing system includes a storage device, an acquisition unit, a display control unit, and a display history extraction unit. The storage device stores a 3D information group including a plurality of 3D information items. The acquisition unit acquires the 3D information group from the storage device. The display control unit causes the plurality of 3D information items to be displayed in accordance with a priority that is predetermined. The display history extraction unit extracts a display history indicating a history of a 3D information item, among the plurality of 3D information items, or another 3D information item that has been displayed. The display control unit causes the 3D information item to be displayed in accordance with a first priority in a case where the display history extraction unit extracts a first display history, and causes the plurality of 3D information items to be displayed in accordance with a second priority different from the first priority in a case where the display history extraction unit extracts a second display history different from the first display history.

According to Aspect 9, an information processing method includes an acquisition step of acquiring a 3D information group including a plurality of 3D information items from a storage device that stores the 3D information group; a display control step of causing the plurality of 3D information items to be displayed in accordance with a priority that is predetermined; and a reception step of receiving attribute information of a user. The display control step includes causing the plurality of 3D information items to be displayed in accordance with a first priority in a case where first attribute information is received in the receiving, and causing the plurality of 3D information items to be displayed in accordance with a second priority different from the first priority in a case where second attribute information different from the first attribute information is received in the receiving.

According to Aspect 10, a program causes a computer to function as acquisition means, display control means, and receiving means. The acquisition means acquires a 3D information group including a plurality of 3D information items. The display control means causes the plurality of 3D information items to be displayed in accordance with a priority that is predetermined. The receiving means receives attribute information of a user. The display control means causes the plurality of 3D information items to be displayed in accordance with

a first priority in a case where first attribute information is received by the receiving means, and causes the plurality of 3D information items to be displayed in accordance with a second priority different from the first priority in a case where second attribute information different from the first attribute information is received by the receiving means.

According to Aspect 11, a program causes a computer to function as acquisition means, priority setting means, and output means. The acquisition means acquires a 3D information group including a plurality of 3D information items. The priority setting means sets a priority in accordance with which the plurality of 3D information items are to be output. The output means outputs the plurality of 3D information items in accordance with the priority set by the priority setting means. The priority setting means includes at least one of receiving means and display history extraction means. The receiving means receives attribute information of a user. The display history extraction means extracts a display history indicating a history of a 3D information item, among the plurality of 3D information items, or another 3D information item that has been displayed. The priority setting means sets the priority, based on at least one of the attribute information and the display history.

[0083]

The present invention can be implemented in any convenient form, for example using dedicated hardware, or a mixture of dedicated hardware and software. The present invention may be implemented as computer software implemented by one or more networked processing apparatuses. The processing apparatuses include any suitably programmed apparatuses such as a general purpose computer, a personal digital assistant, a Wireless Application Protocol (WAP) or third-generation (3G)-compliant mobile telephone, and so on. Since the present invention can be implemented as software, each and every aspect of the present invention thus encompasses computer software implementable on a programmable device. The computer software can be provided to the programmable device using any conventional carrier medium (carrier means). The carrier medium includes a transient carrier medium such as an electrical, optical, microwave, acoustic or radio frequency signal carrying the computer code. An example of such a transient medium is a Transmission Control Protocol/Internet Protocol (TCP/IP) signal carrying computer code over an IP network, such as the Internet. The carrier medium may also include a storage medium for storing processor readable code such as a floppy disk, a hard disk, a compact disc read-only memory (CD-ROM), a magnetic tape device, or a solid state memory device.

[0084]

The functionality of the elements disclosed herein may be implemented using circuitry or processing circuitry which includes general purpose processors, special purpose processors, integrated circuits, application-specific integrated circuits (ASICs), field-programmable gate arrays (FPGAs), and/or combinations thereof which are configured or programmed, using one or more programs stored in one or more memories, to perform the disclosed functionality. Processors are considered processing circuitry or circuitry as they include transistors and

other circuitry therein. In the disclosure, the circuitry, units, or means are hardware that carry out or are programmed to perform the recited functionality. The hardware may be any hardware disclosed herein which is programmed or configured to carry out the recited functionality.

There is a memory that stores a computer program which includes computer instructions. These computer instructions provide the logic and routines that enable the hardware (e.g., processing circuitry or circuitry) to perform the method disclosed herein. This computer program can be implemented in known formats as a computer-readable storage medium, a computer program product, a memory device, a record medium such as a CD-ROM or DVD, and/or the memory of an FPGA or ASIC.

[0085]

This patent application is based on and claims priority to Japanese Patent Application No. 2024-033408, filed on March 5, 2024, in the Japan Patent Office, the entire disclosure of which is hereby incorporated by reference herein.

[Reference Signs List]

[0086]

10, 10A information processing apparatus

10B server apparatus

11 storage device

14A display device

20A reception unit

20B priority setting unit

20C acquisition unit

20D display data generation unit

20E display control unit

[CLAIMS]

1. An information processing system comprising:
 - a storage device configured to store a three-dimensional (3D) information group including a plurality of 3D information items;
 - an acquisition unit configured to acquire the 3D information group from the storage device;
 - a display control unit configured to display, on a display, the plurality of 3D information items according to a priority that is predetermined; and
 - a reception unit configured to receive attribute information of a user, wherein the display control unit is configured to:
 - cause the plurality of 3D information items to be displayed according to a first priority in a case where the reception unit receives first attribute information; and
 - cause the plurality of 3D information items to be displayed according to a second priority different from the first priority in a case where the reception unit receives second attribute information different from the first attribute information.
2. The information processing system according to claim 1, wherein the priority is set based on the attribute information and additional information related to the plurality of 3D information items.
3. The information processing system according to claim 2, wherein the plurality of 3D information items include 3D information items of a plurality of components in a space, and the additional information includes at least one of a configuration, an area, a height, a number of tenants, a number of rooms, a role, and a purpose of the space and the plurality of components.
4. The information processing system according to any one of claims 1 to 3, wherein the attribute information includes at least one of an occupation, a duty, an age, a position, and a duration of service of the user.
5. The information processing system according to any one of claims 1 to 4, further comprising:
 - a priority setting unit configured to set the priority, wherein
 - the acquisition unit is configured to acquire the plurality of 3D information items of the 3D information group according to the priority set by the priority setting unit.
6. The information processing system according to any one of claims 1 to 5, wherein

the plurality of 3D information items include a plurality of low-quality 3D information items and a plurality of high-quality 3D information items having a higher resolution than a resolution of the plurality of low-quality 3D information items, and

the display control unit is configured to cause the plurality of high-quality 3D information items to be displayed according to the priority.

7. The information processing system according to any one of claims 1 to 5, wherein

the plurality of 3D information items include a plurality of low-quality 3D information items and a plurality of high-quality 3D information items having a higher resolution than a resolution of the plurality of low-quality 3D information items,

the plurality of low-quality 3D information items include a first low-quality 3D information item corresponding to a first component and a second low-quality 3D information item corresponding to a second component,

the plurality of high-quality 3D information items include a first high-quality 3D information item corresponding to the first component and a second high-quality 3D information item corresponding to the second component, and

the priority of the first high-quality 3D information item is higher than the priority of the first low-quality 3D information item, and the priority of the second high-quality 3D information item is lower than the priority of the second low-quality 3D information item.

8. An information processing system comprising:

a storage device configured to store a 3D information group including a plurality of 3D information items;

an acquisition unit configured to acquire the 3D information group from the storage device;

a display control unit configured to display, on a display, the plurality of 3D information items according to a priority that is predetermined; and

a display history extraction unit configured to extract a display history indicating a history of a 3D information item, among the plurality of 3D information items, or another 3D information item that has been displayed, wherein

the display control unit is configured to:

cause the 3D information item to be displayed according to a first priority in a case where the display history extraction unit extracts a first display history; and

cause the plurality of 3D information items to be displayed according to a second priority different from the first priority in a case where the display history extraction unit extracts a second display history different from the first display history.

9. An information processing method comprising:

acquiring a 3D information group including a plurality of 3D information items from a storage device that stores the 3D information group;

displaying, on a display, the plurality of 3D information items according to a priority that is predetermined; and

receiving attribute information of a user, wherein
the displaying includes

displaying the plurality of 3D information items according to a first priority in a case where first attribute information is received in the receiving, and

displaying the plurality of 3D information items according to a second priority different from the first priority in a case where second attribute information different from the first attribute information is received in the receiving.

10. A computer program product comprising instructions which, when executed by a computer, cause the computer to carry out a method comprising:

acquiring a 3D information group including a plurality of 3D information items;

displaying, on a display, the plurality of 3D information items according to a priority that is predetermined; and

receiving attribute information of a user, wherein

the displaying includes:

displaying the plurality of 3D information items according to a first priority in a case where first attribute information is received in the receiving; and

displaying the plurality of 3D information items according to a second priority different from the first priority in a case where second attribute information different from the first attribute information is received in the receiving.

11. A computer program product comprising instructions which, when executed by a computer, cause the computer to carry out a method comprising:

acquiring a 3D information group including a plurality of 3D information items;

setting a priority in accordance with which the plurality of 3D information items are to be output; and

outputting the plurality of 3D information items according to the set priority, wherein the setting includes at least one of:

receiving attribute information of a user, the priority being set based on the attribute information; and

extracting a display history indicating a history of a 3D information item, among the plurality of 3D information items, or another 3D information item that has been displayed, the display history being set based on the attribute information.