(12) INNOVATION PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. **AU 2020104485 A4**

(54) Title
An asset virtualisation system

(51) International Patent Classification(s)
G09B 5/02 (2006.01)
G06F 3/04815 (2022.01)
G06F 16/54 (2019.01)
G06F 16/587 (2019.01)
G06F 16/955 (2019.01)
G06Q 90/00 (2006.01)
G06T 17/05 (2011.01)
G06T 19/00 (2011.01)
G09B 9/00 (2006.01)
G06T 7/38 (2017.01)
H04N 21/4223 (2011.01)

(21) Application No: **2020104485**
(22) Date of Filing: **2020.04.03**

(30) Priority Data

(31) Number	(32) Date	(33) Country
2019904677	**2019.12.10**	**AU**

(45) Publication Date: **2021.06.17**
(45) Publication Journal Date: **2022.09.22**
(45) Granted Journal Date: **2022.09.22**

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Abstract

An asset virtualisation system is disclosed that comprises a database arranged to store image data indicative of a visual representation of a plurality of assets in 3-dimensional space, the image data including image data associated with each asset including image data associated with a plurality of asset areas. The system also includes a user interface arranged to facilitate access by authorized users to the stored image data, the system arranged, for each asset, to organize the image data associated with the asset and the plurality of asset areas in a hierarchical structure such that a user is able to navigate through the structure to select an asset area to be viewed. The user interface is controllable by a user to display a selected portion of an asset area in 3- dimensional space and display adjacent portions of the asset area by receiving navigation instructions from the user. The image data is organised in a hierarchical structure, and each node of the hierarchical structure has an associated web address such that a user is able to navigate through the hierarchical structure using web hyperlinks.

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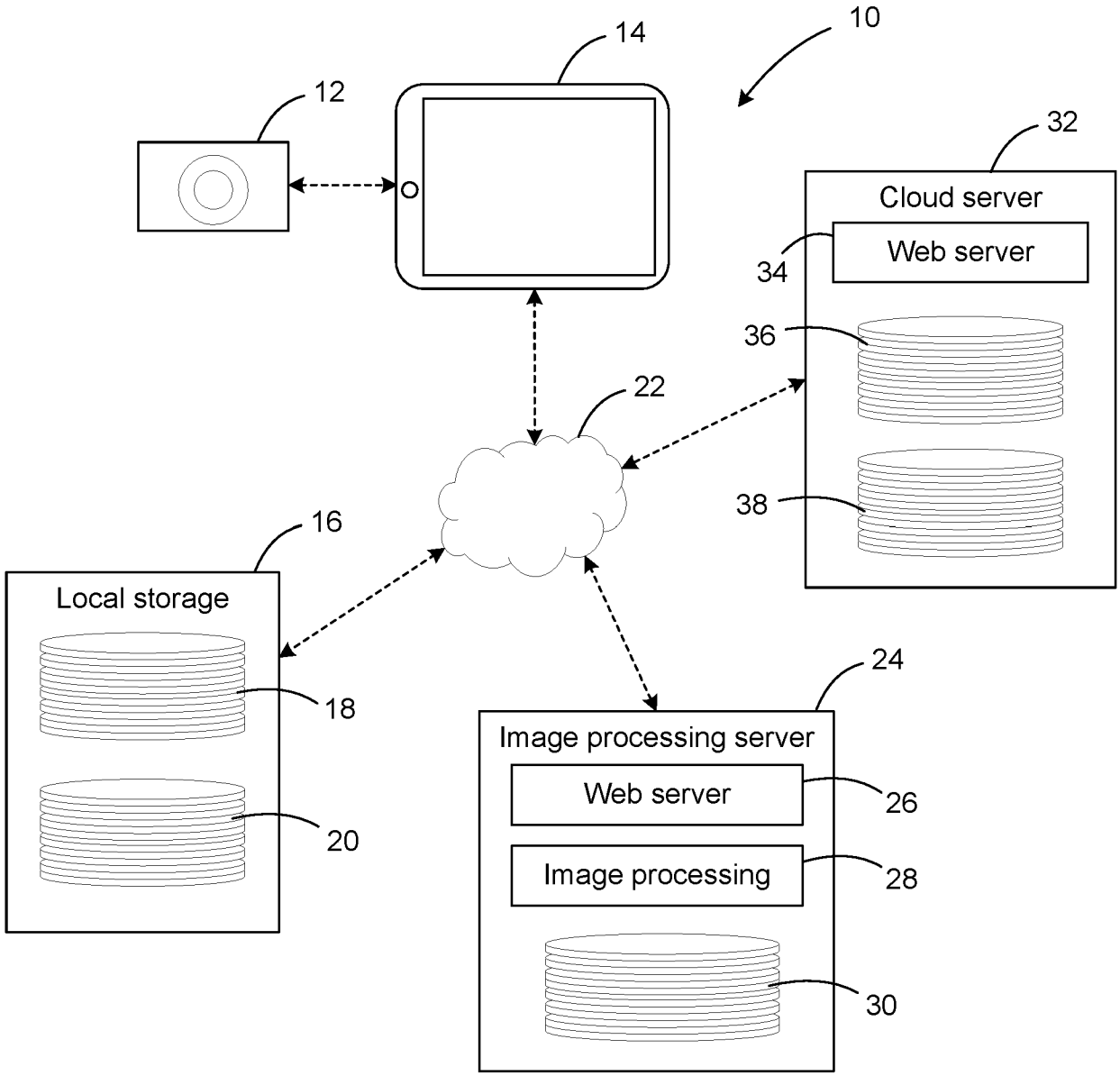

Fig. 1

AN ASSET VIRTUALISATION SYSTEM

Field of the Invention

The present invention relates to an asset virtualisation system, and in particular to an asset virtualisation system for use with an asset in a resources, chemical, shipping or telecommunications industry.

Background of the Invention

An organisation may have several assets that are disposed at different remote locations. For example, in the resources industry it is common for assets to exist at difficult to access remote locations, such as offshore. Such assets in the resources industry are also typically complex and extensive in size, and hazardous in the sense that lack of familiarity with the asset by a person can pose an increased risk to the person.

Typically, an organisation provides people with asset training by transporting the people to the asset and providing training at the asset to familiarise the people with the asset in a controlled way. However, transporting people to an asset is typically expensive because the asset is at a location that is difficult to access, and providing the training on site at the asset can result in impairment to productivity.

Summary of the Invention

In accordance with a first aspect of the present invention, there is provided an asset virtualisation system comprising:

a database arranged to store image data indicative of a visual representation of a plurality of assets in 3-dimensional space, the image data including image data associated with each asset including image data associated with a plurality of asset areas; and

a user interface arranged to facilitate access by authorized users to the stored image data, the system arranged, for each asset, to organize the image data associated with the asset and the plurality of asset areas in a hierarchical structure such that a user is able to navigate through the structure to select an asset area to be

viewed;

wherein the user interface is controllable by a user to:

display a selected portion of an asset area in 3-dimensional space; and

display adjacent portions of the asset area by receiving navigation instructions from the user; and

wherein the image data is organised in a hierarchical structure, and each node of the hierarchical structure has an associated web address such that a user is able to navigate through the hierarchical structure using web hyperlinks.

In an embodiment, the system is arranged to store point cloud data indicative of a representation of at least a portion of at least one asset, the user interface arranged to facilitate access by authorized users to the stored point cloud data.

The point cloud data indicative of a representation of at least a portion of an asset may be free standing such that the point cloud data is not geospatially aligned with the image data associated with the portion of the asset and/or with a map or plan of the portion of the asset.

Alternatively, the point cloud data indicative of a representation of at least a portion of an asset may be geospatially aligned with the image data associated with the portion of the asset and/or with a map or plan of the portion of the asset.

In an embodiment, the asset virtualisation system comprises at least one camera and an image capturing computing device, the image capturing computing device including an image capturing application, and the at least one camera and the image capturing computing device arranged to communicate with each other such that image capture by the at least one camera is controllable by the image capturing application on the image capturing computing device. The image capturing computing device may be a tablet computer.

In an embodiment, the image capturing computing application is arranged to facilitate selection of the resolution of image capture.

In an embodiment, the system is arranged to transfer image data captured by the image capturing computing device to a local storage device.

In an embodiment, the system comprises an image processing server arranged to receive the image data and process the image data so as to register and automatically stitch together image data portions associated with adjacent scanned spaces.

The image processing server may be arranged to provide an Internet accessible user interface arranged to facilitate editing of the image data by a user. The image data may be editable so as to add visible tags to items in the captured images and/or so as to make adjustments to the stitched image data to remove unnecessary image portions and/or correct registration alignment errors.

In an embodiment, the system comprises a cloud server arranged to store image data received from the image processing server and facilitate access by authorized users to the stored image data. The stored image data may be organised in a navigable hierarchical structure to facilitate ease of access to desired visual representations by a user. The processed image data may be organised according to asset geographical area, asset group, asset and asset area.

In an embodiment, the image data is organised in a hierarchical structure according to asset geographical area, asset group, asset and asset area.

Brief Description of the Drawings

The present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a schematic block diagram of an asset virtualisation system in accordance with an embodiment of the present invention;

Figure 2 is a diagrammatic representation of space scanning components of the system shown in Figure 1;

Figure 3 is a schematic block diagram of content viewing components of the system shown in Figure 1;

Figure 4 is a representation of an example home screen displayed to a user by the content viewing components shown in Figure 3;

Figure 5 is a representation of an example country screen displayed to a user by the content viewing components shown in Figure 3;

Figure 6 is a representation of an example asset group screen displayed to a user by the content viewing components shown in Figure 3;

Figure 7 is a representation of an example asset screen displayed to a user by the content viewing components shown in Figure 3;

Figure 8 is a representation of an example asset area screen displayed to a user by the content viewing components shown in Figure 3; and

Figure 9 is a representation of an example asset view screen displayed to a user by the content viewing components shown in Figure 3;

Description of an Embodiment of the Invention

Referring to Figure 1 of the drawings, there is shown an asset virtualisation system 10 for capturing visual representations of a plurality of assets in 3-dimensional space, organising visual representations of the plurality of assets and a plurality of asset areas of each asset in a navigable hierarchical structure, facilitating access to the visual representations by a user to enable the user to display selected portions of an asset in 3-dimensional space, and facilitating navigation through the 3-dimensional space by the user.

The asset virtualisation system 10 includes a camera 12 capable of capturing images representative of 3-dimensional space, for example by rotatably mounting the camera 12 on a stand 44, as shown in Figure 2, or by configuring the camera 12 so that optical components of the camera 12 rotate. In the present embodiment, 2 different cameras 12 are used, a first camera 12 that is particularly suitable for capturing images representative of 3-dimensional space when the 3-dimensional space has relatively low light conditions as typically exist internally of an asset, and a second camera 12

that is particularly suitable for capturing images representative of 3-dimensional space when the 3-dimensional space has relatively high light conditions as typically exist externally of the asset.

In this example, the first camera is a Matterport HD 360 camera and the second camera is a Leica BLK 360 Scanner, although it will be understood that any suitable camera(s) 12 is/are envisaged.

In this example, the Leica BLK 360 Scanner is also able to capture point cloud data representative of a scanned area, the point cloud data used to provide a user with 3-dimensional information about a scanned space to supplement the images representative of the 3-dimensional space.

The asset virtualisation system 10 also includes an image capturing computing device 14, in this example a tablet computer 14, that implements an image capturing application arranged to interface with the camera 12 to control capture of image data using the camera 12 and receive captured image data from the camera 12 for storage on the tablet computer 14. In this example, the image capturing application is provided by Matterport Inc.

As shown in Figure 2, in order to capture image data indicative of a visual representation of a 3-dimensional space 42, a user disposes the camera 12 in the space 42 desired to be scanned and uses the image capturing application on the tablet computer 14 to cause the camera or a portion of the camera to rotate and capture image data representative of the space. The resolution used for each scan may be modified according to the level of resolution required for the space. For example, if the space has readable indicia, the scan may be carried out at a relatively high resolution, and if the space predominantly has building walls, the scan may be carried out at a relatively low resolution.

In this example, the tablet computer 14 communicates with the camera 12 using an ad hoc network created by the camera 12, although it will be understood that other arrangements are possible. For example, the camera 12 and tablet computer 14 may communicate with each other using an existing local network, such as an existing WiFi network.

In this example, the camera 12 used is a Matterport HD 360 camera since the space 42 is an internal space of an asset, such as an internal space of a gas processing plant.

In this example, image data representative of external spaces are also desired, and for this purpose an alternate camera – such as a Leica BLK 360 Scanner - is used.

In this example, point cloud data is also captured using the tablet computer 14 and the alternate camera 12.

After the image data and the point cloud data have been captured by the tablet computer 14 and the camera(s) 12, the captured image data and the point cloud data are transferred to a local storage device 16 that may be a computing device such as a desktop computer or laptop computer, for storage at the local storage device 16 as image data records 18 and point cloud data records 20.

The image capturing process is carried out for all spaces of the asset that are desired to be imaged, in this example all internal and relevant external areas of the asset.

In this example, the tablet computer 14 is in communication with the local storage device 16 using an existing local WiFi network, although it will be understood that any suitable communication arrangement is envisaged.

In this example, the point cloud data stored at the local storage device 16 is processed, for example at the local storage device 16, in order to register the point cloud data and generate a point cloud that can be exported to various file formats according to desired specifications. In this example, the point cloud data is processed using Cyclone Register 360 software produced by Leica.

In this example, the generated point cloud is free standing in the sense that it is not geospatially aligned to the image data or any map or plan of the relevant asset.

The generated point cloud may be viewed using any suitable software application, such as any suitable CAD application.

In an alternative arrangement, the point cloud is geospatially aligned with a map or plan of the relevant asset. With this example, a plurality of target features of the spaces to be scanned are identified by a survey user and the 3-dimensional locations of the identified targets on a map or plan are recorded, for example at the local storage device 16, in any suitable format, such as in a CSV file. After the spaces have been scanned, the targets are identified in the point cloud and linked to the stored locations so as to align the target features on the map or plan with the target features in the point cloud and thereby geospatially align the map or plan to the point cloud. The geospatial alignment may be carried out using the Cyclone Register 360 software.

The asset virtualisation system 10 also includes an image processing server 24 that receives image data from the local storage device 16, for example through the local WiFi network 22 and the Internet automatically or in response to manual instruction. The image processing server 24 includes a web server 26 arranged to provide an Internet accessible user interface, and image processing functionality 28 arranged to process the image data so as to produce processed image data records 28. In particular, the image processing functionality 28 carries out registration and automatic stitching together of the captured image data associated with the various scanned spaces, so that a representation of an asset or asset area derived from multiple image scans is provided in 3-dimensional space that a user can navigate through. In this example, the image processing server 24 is provided by Matterport Inc.

The image processing server 24 may also facilitate editing of the image data so as to add visible tags to items in the captured images, for example so as to add a link to a manual for an item.

The image processing server 24 through the web server 26 also facilitates access by a user for the purpose of validating the registration and automatic stitching of the image data carried out by the image processing functionality, and if necessary making adjustments to the stitched image data, for example to remove unnecessary image portions and/or correct registration alignment errors.

The asset virtualisation system 10 also includes a cloud server 32 that receives image data from the image processing server 24, for example through the local WiFi network

22 and the Internet automatically or in response to manual instruction. The cloud server 32 includes a web server 34 arranged to provide an Internet accessible user interface that enables a user to access processed image data records 36 received from the image processing server 24 and point cloud data records 38 received from the local storage device 16. The processed image data 36 is organised in a navigable hierarchical structure to facilitate ease of access to desired visual representations by a user. In this example, the processed image data 36 is organised according to nodes corresponding to asset geographical area, asset group, asset and asset area, and this enables a user to quickly access the desired asset and view the desired portion of the asset.

In this example, the hierarchical structure is arranged such that each node of the hierarchical structure has an associated web address, and in this way a user is able to navigate through the hierarchical structure using hyperlinks.

In this example, the cloud server is hosted by Amazon Web Services, although it will be understood that other implementations are possible.

Example content viewing components of the system are shown in Figure 3.

In order to access the image data 36 and the point cloud data 38 stored at the cloud server 32, a user may connect to the cloud server 32, for example through a wide area network such as the Internet 50, using any suitable computing device.

In this example, the system is arranged so that access to the image data 36 and/or the point cloud data 38 is controlled, and this may be achieved by providing each authorised user with login credentials recognised by the cloud server 32. Alternatively, as shown in Figure 3, users of an organisation may be provided with individual login credentials that enable the users to access the organisation's network, and the organisation 52 may be provided with login credentials for accessing the cloud server 32. In this way, an organisation is able to facilitate and control access to the image data 36 and/or the point cloud data 38 without the need to provide each individual user with login credentials for the cloud server 32. In this example, the organisation 52 is provided with an external network interface component 64 that stores local login data 66 associated with individual users of the organisation 52, and cloud server login data

68 associated with the cloud server 32.

A user of the organisation is able to access the image data 36 and/or the point cloud data 38 using any suitable computing device, including a laptop or personal computer 54, a smartphone 56, a tablet computer 58 or a virtual reality content delivery device, for example that includes a VR headset 60.

In this example, each computing device accesses the image data 36 and/or the point cloud data 38 through a local organisation network, that may include a local organisation WiFi and/or hard-wired network.

During use, when a user of the organisation 52 desires to access the image data 36 and/or the point cloud data 38 stored at the cloud server 32, the user directs the relevant computing device 54, 56, 58, 60 to a website address associated with the cloud server 32. The access request is analysed by the external network interface 64 to determine whether the requesting user has appropriate login credentials associated with the organisation 52 and, if so, the external network interface establishes a connection between the organisation 52 and the cloud server 32 using the cloud server login data 68.

Example screens displayed to an authorised user when the authorised user is granted access to the cloud server 32 using a web browser 72 are shown in Figures 4 to 9.

After access to the cloud server 32 has been granted, a home screen 70 is displayed in the web browser 72. The home screen 70 includes a menu 74 having selectable tabs 75, in this example each tab 75 corresponding to an asset group that the user is authorised to access. In this example, the menu 74 may be displayed on all displayed screens or on some of the available screens so as to provide the user with quick access to another asset group.

The home screen 70 also includes a world map 76 that includes highlighted countries 78 representing the countries in which an asset group to which the user is authorised to access is located.

The selectable asset group tabs 75 and highlighted countries 78 are each associated

with a hyperlink to a relevant web address associated with a country or asset group node in the image data hierarchical structure.

If the user selects an asset country 78, a country screen 80 is displayed, as shown in Figure 5.

The country screen 80 includes asset group tiles 82 corresponding to respective asset groups. For example, an asset group may correspond to a liquefied natural gas (LNG) processing plant that includes several assets arranged to perform various aspects of LNG processing. In this example, the asset group tiles 82 each include a representation of the relevant asset group.

The selectable asset group tiles 82 are each associated with a hyperlink to a relevant web address associated with an asset group node in the image data hierarchical structure.

If the user selects an asset group 82, an asset group screen 84 is displayed, as shown in Figure 6.

The asset group screen 84 includes asset tiles 86 corresponding to respective assets that form part of the asset group. For example, assets of an asset group may correspond to individual platforms of a project. In this example, the asset tiles 86 each include a representation of the relevant asset.

The selectable asset tiles 86 are each associated with a hyperlink to a relevant web address associated with an asset node in the image data hierarchical structure.

If the user selects an asset 86, an asset screen 88 is displayed, as shown in Figure 7.

The asset screen 88 includes a map drop down box 90 usable to display a map of the asset with selectable asset areas, and asset area tiles 92 corresponding to respective areas of the asset. In this example, the asset area tiles 92 each include a representation of the relevant asset area.

The selectable asset area tiles 92 are each associated with a hyperlink to a relevant

web address associated with an asset area node in the image data hierarchical structure.

If the user selects an asset area 92, an asset area screen 94 is displayed, as shown in Figure 8.

The asset area screen 94 includes a play button 96 that when activated causes an asset view screen 100 to be displayed, as shown in Figure 9. The asset area screen 94 also includes selectable links 98 usable to directly access other areas of the selected asset.

As shown in Figure 9, when an asset area play button 96 is activated, an asset representation 102 is shown on the asset view screen 100. The asset representation 102 is navigable in the sense that a user is able to navigate through a visual representation of an asset area in 3-dimensional space, using suitable controls such as a mouse. It will be understood that a user is also able to view the visual asset representation 102 and navigate through the visual representation of the asset area using a suitable VR content viewing device such as a VR headset and associated navigation controls.

It will be appreciated that the asset visualisation system 10 may be used to provide employees of an organisation with asset and situational awareness for remote assets without the need to travel to the assets. In this way, familiarity with the assets is achieved without any impairment to productivity or increased costs due to unfamiliarity with the assets and site travel.

It will also be appreciated that the asset visualisation system 10 improves asset awareness and provides safety and productivity benefits to an organisation, in that the system provides employees with an immersive experience that for example can be used to provide realistic off-site learning experiences.

In an example, a marine vessel such as a naval vessel could be virtualised using the system 10 so that necessary training, maintenance, inspection and project activities that need to occur on a vessel can be planned and coordinated prior to the vessel docking in port.

It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the common general knowledge in the art, in Australia or any other country.

In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word “comprise” or variations such as “comprises” or “comprising” is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

Modifications and variations as would be apparent to a skilled addressee are determined to be within the scope of the present invention.

The claims defining the invention are as follows:

1. An asset virtualisation system comprising:

a database arranged to store image data indicative of a visual representation of a plurality of assets in 3-dimensional space, the image data including image data associated with each asset including image data associated with a plurality of asset areas; and

a user interface arranged to facilitate access by authorized users to the stored image data, the system arranged, for each asset, to organize the image data associated with the asset and the plurality of asset areas in a hierarchical structure such that a user is able to navigate through the structure to select an asset area to be viewed;

wherein the user interface is controllable by a user to:

display a selected portion of an asset area in 3-dimensional space; and

display adjacent portions of the asset area by receiving navigation instructions from the user; and

wherein the image data is organised in a hierarchical structure, and each node of the hierarchical structure has an associated web address such that a user is able to navigate through the hierarchical structure using web hyperlinks.

2. A system as claimed in claim 1, wherein the system is arranged to store point cloud data indicative of a representation of at least a portion of at least one asset, the user interface arranged to facilitate access by authorized users to the stored point cloud data.

3. A system as claimed in claim 2, wherein the point cloud data indicative of a representation of at least a portion of an asset is free standing such that the point cloud data is not geospatially aligned with the image data associated with the portion of the asset and/or with a map or plan of the portion of the asset.

4. A system as claimed in claim 2, wherein the point cloud data indicative of a representation of at least a portion of an asset is geospatially aligned with the image data associated with the portion of the asset and/or with a map or plan of the portion of the asset.

5. A system as claimed in any one of the preceding claims, wherein the asset virtualisation system comprises at least one camera and an image capturing computing device, the image capturing computing device including an image capturing application, and the at least one camera and the image capturing computing device arranged to communicate with each other such that image capture by the at least one camera is controllable by the image capturing application on the image capturing computing device.

6. A system as claimed in claim 5, wherein the image capturing computing device is a tablet computer.

7. A system as claimed in claim 5 or claim 6, wherein the image capturing computing application is arranged to facilitate selection of the resolution of image capture.

8. A system as claimed in any one of claims 5 to 7, wherein the system is arranged to transfer image data captured by the image capturing computing device to a local storage device.

9. A system as claimed in any one of the preceding claims, wherein the system comprises an image processing server arranged to receive the image data and process the image data so as to register and automatically stitch together image data portions associated with adjacent scanned spaces.

10. A system as claimed in claim 9, wherein the image processing server is arranged to provide an Internet accessible user interface arranged to facilitate editing of the image data by a user.

11. A system as claimed in claim 10, wherein the image data is editable so as to add visible tags to items in the captured images and/or so as to make adjustments to the stitched image data to remove unnecessary image portions and/or correct registration alignment errors.

12. A system as claimed in any one of claims 9 to 11, wherein the system comprises a cloud server arranged to store image data received from the image

processing server and facilitate access by authorized users to the stored image data.

13. A system as claimed in any one of the preceding claims, wherein the image data is organised in a hierarchical structure according to asset geographical area, asset group, asset and asset area.

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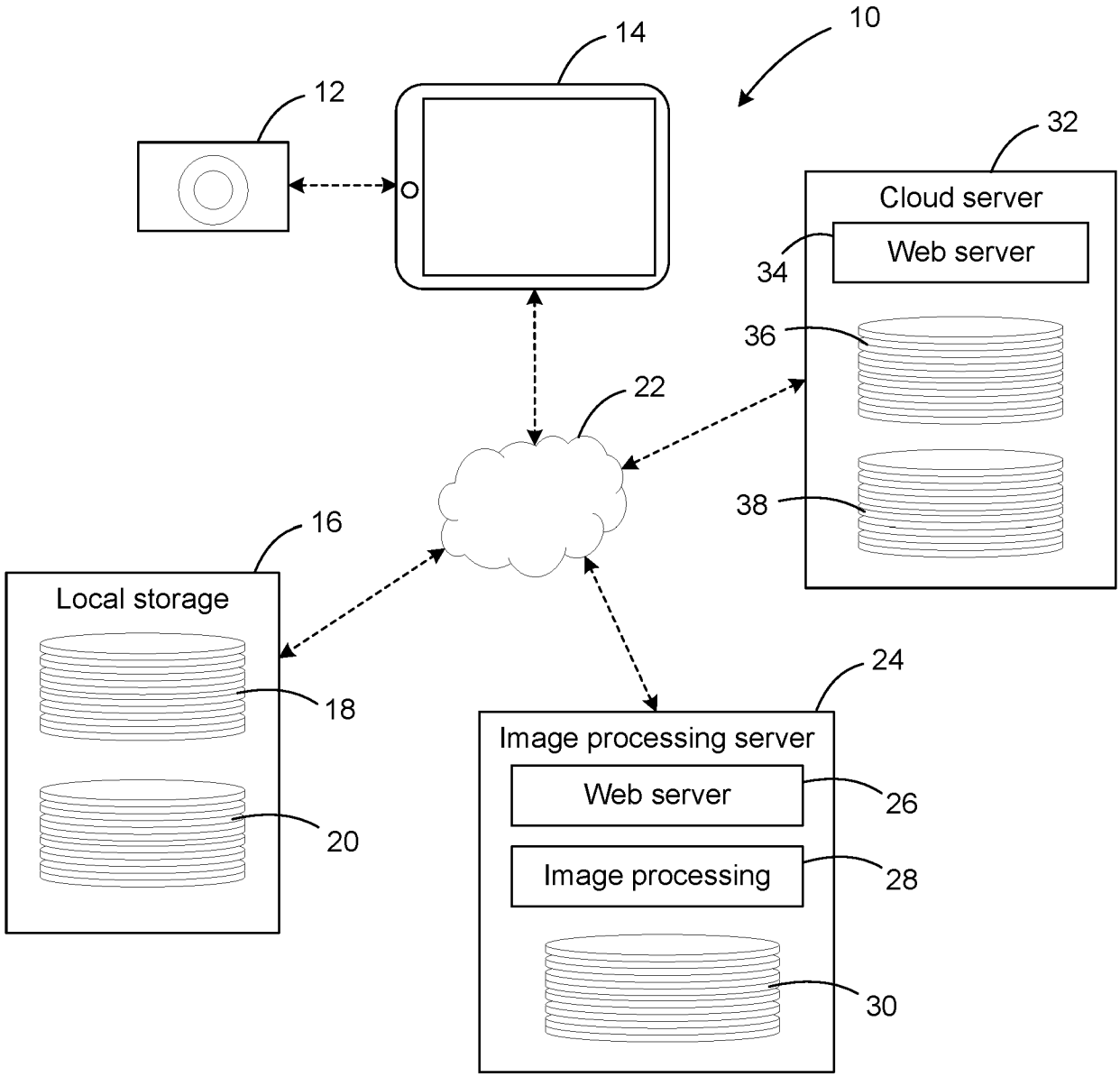

Fig. 1

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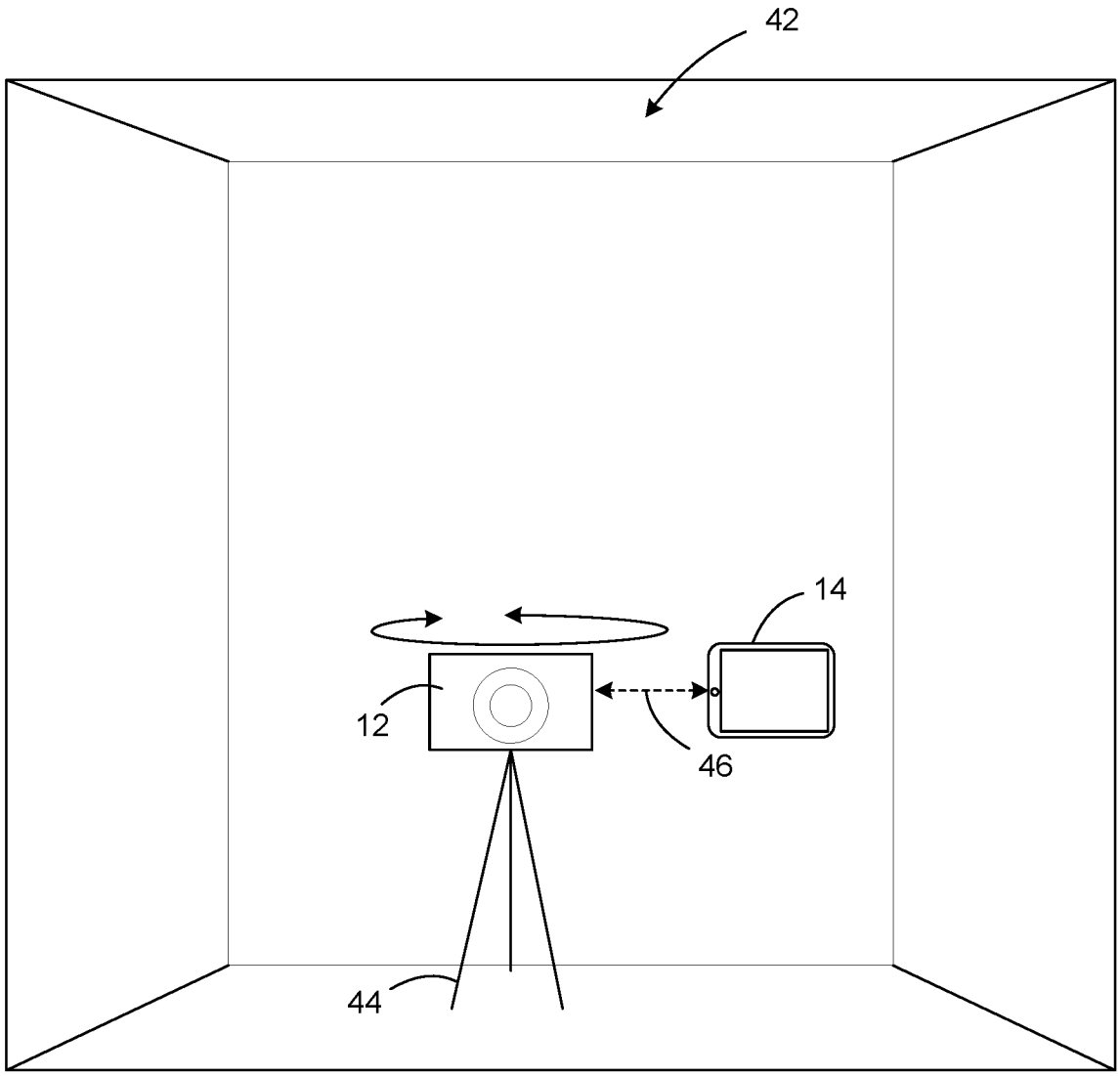

Fig. 2

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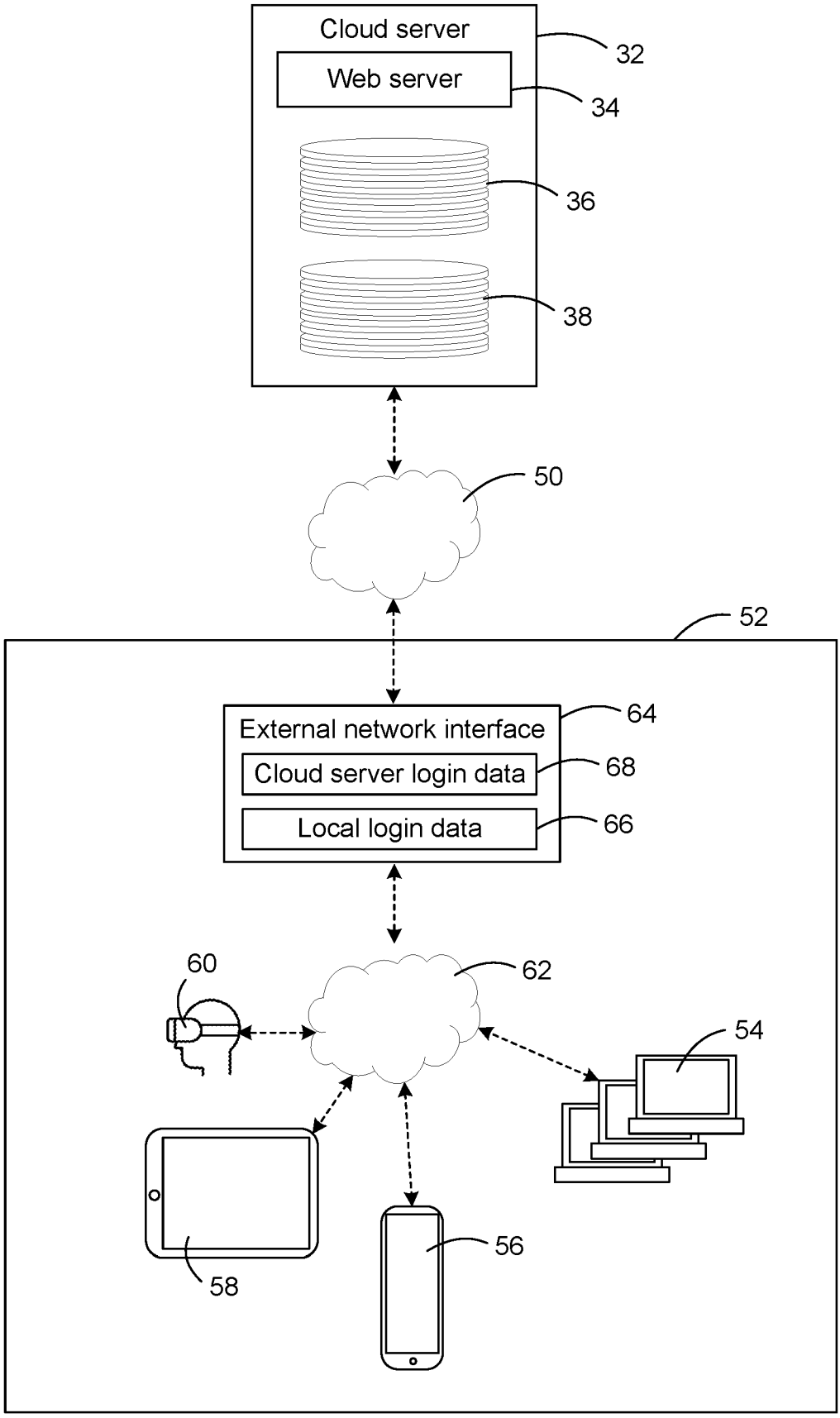

Fig. 3

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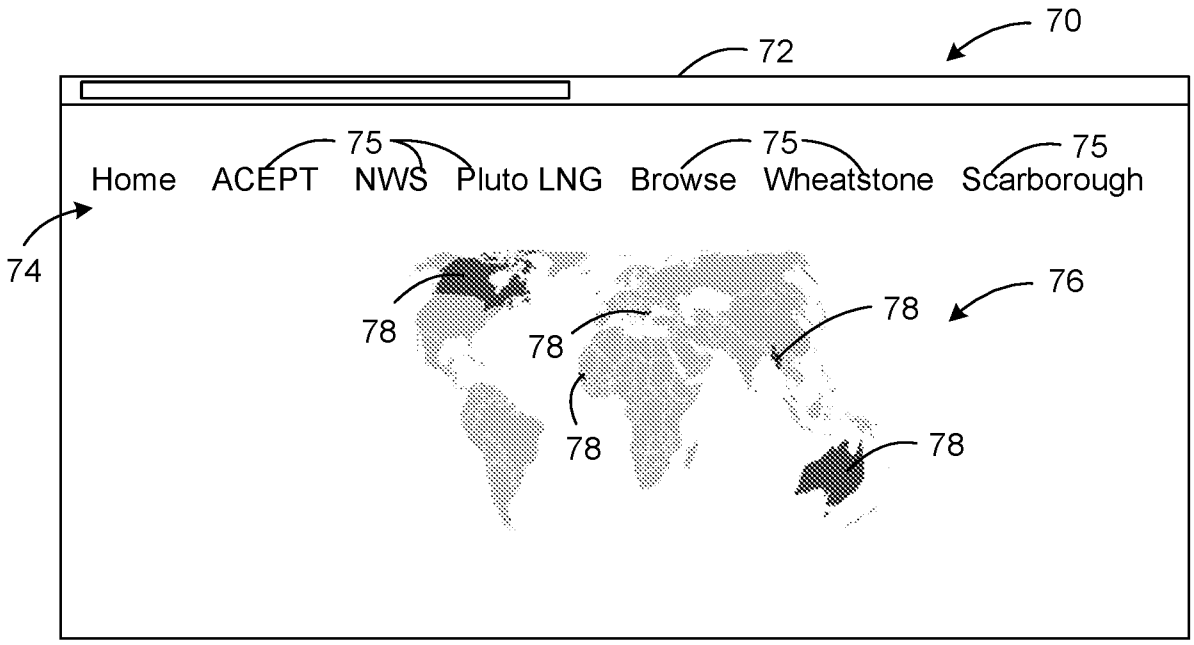

Fig. 4

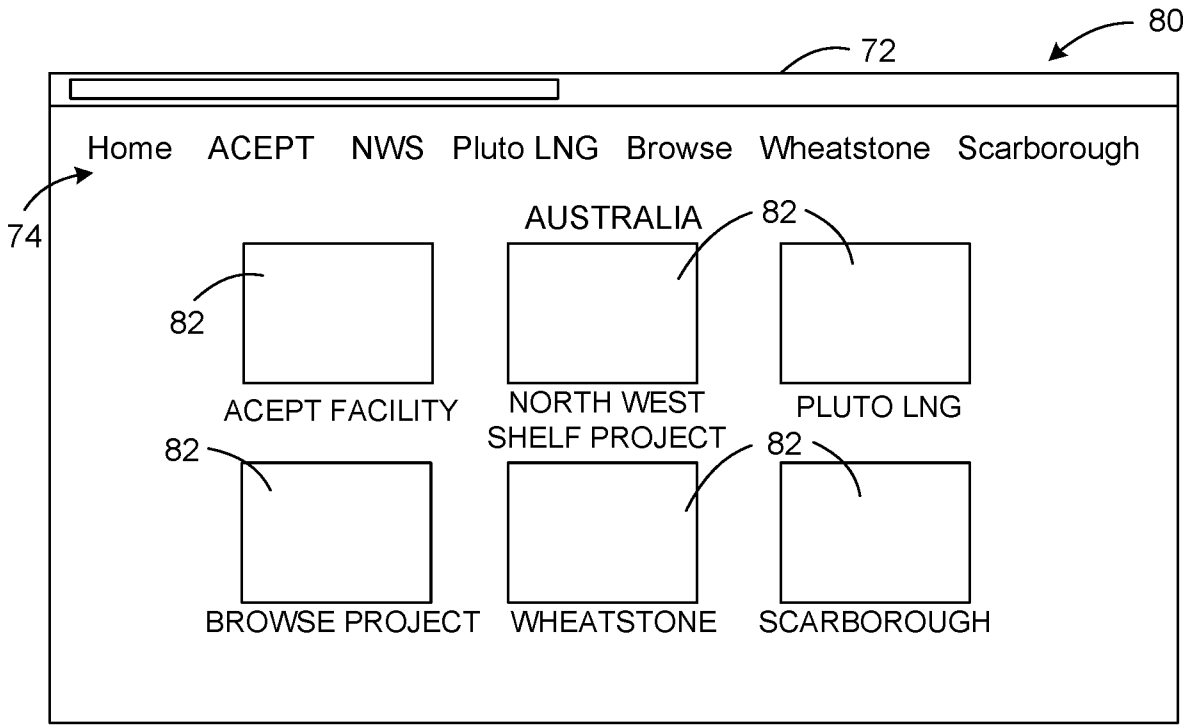

Fig. 5

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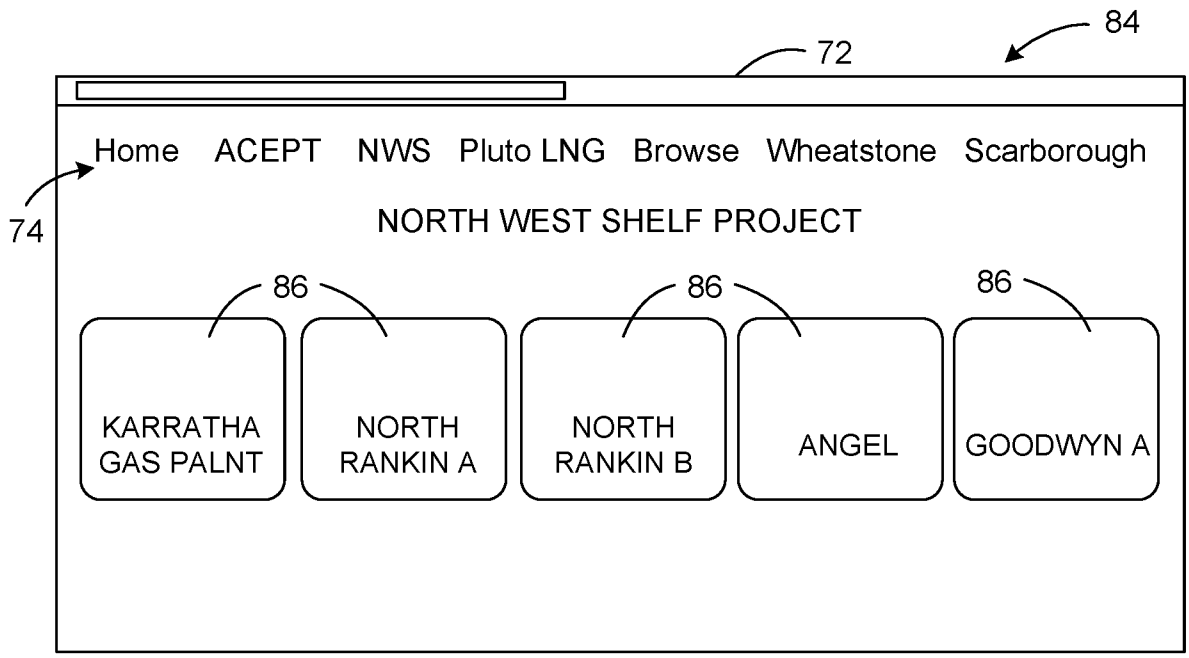

Fig. 6

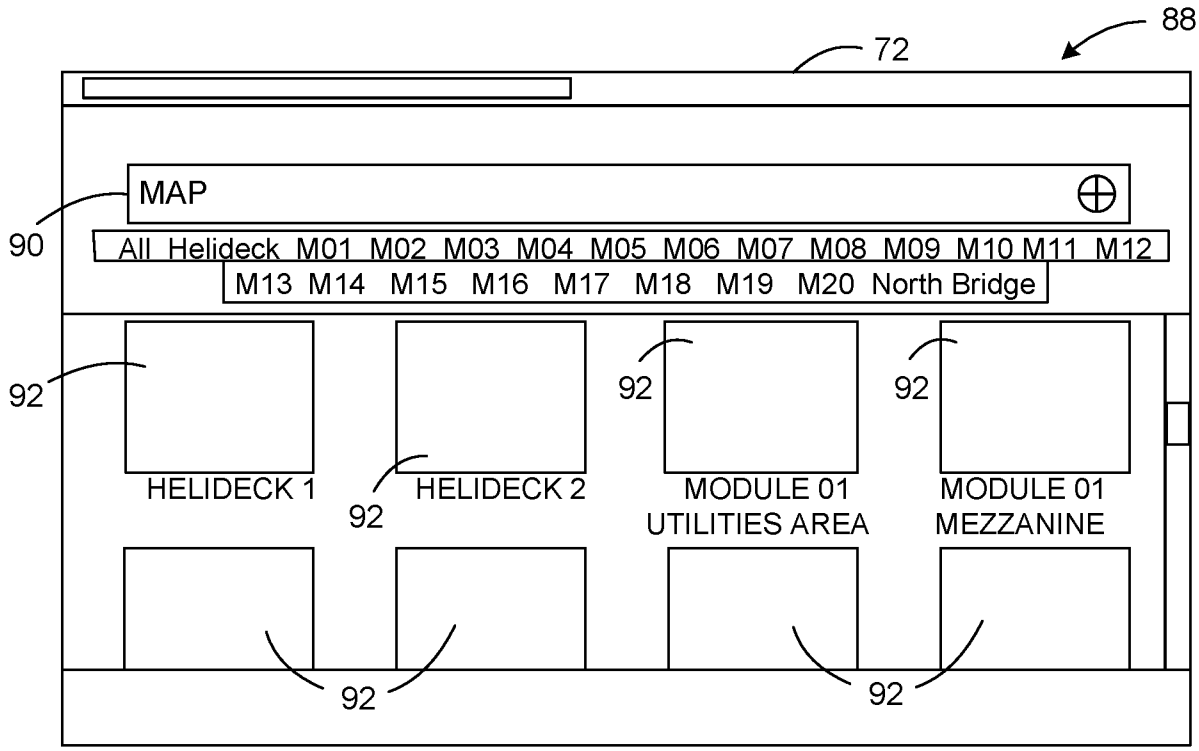

Fig. 7

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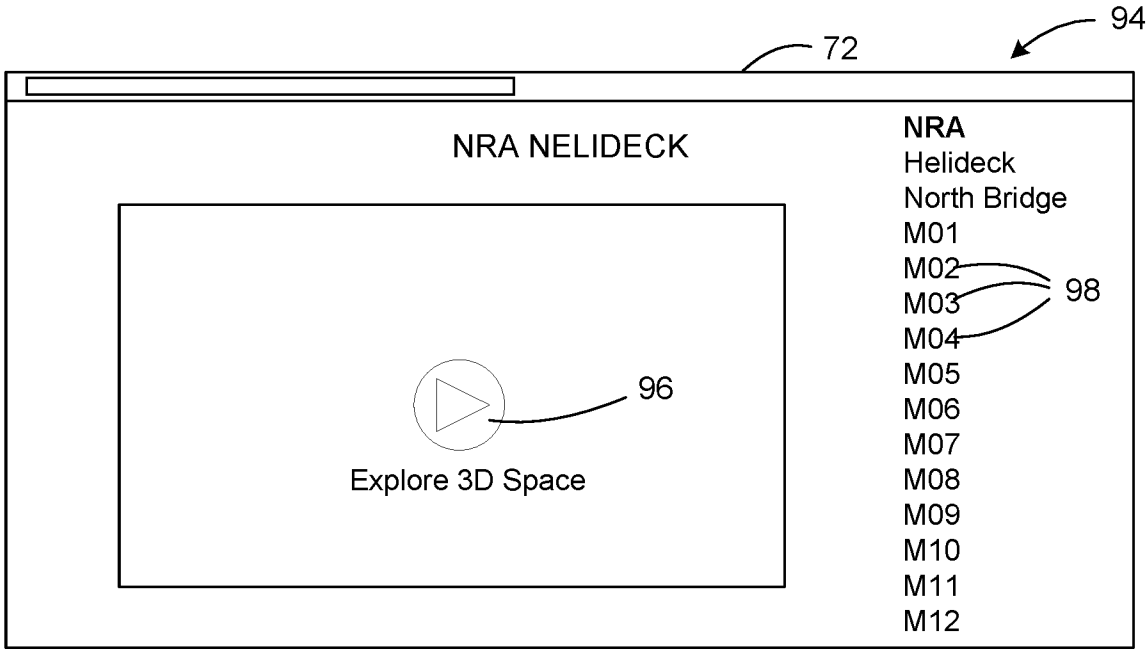

Fig. 8

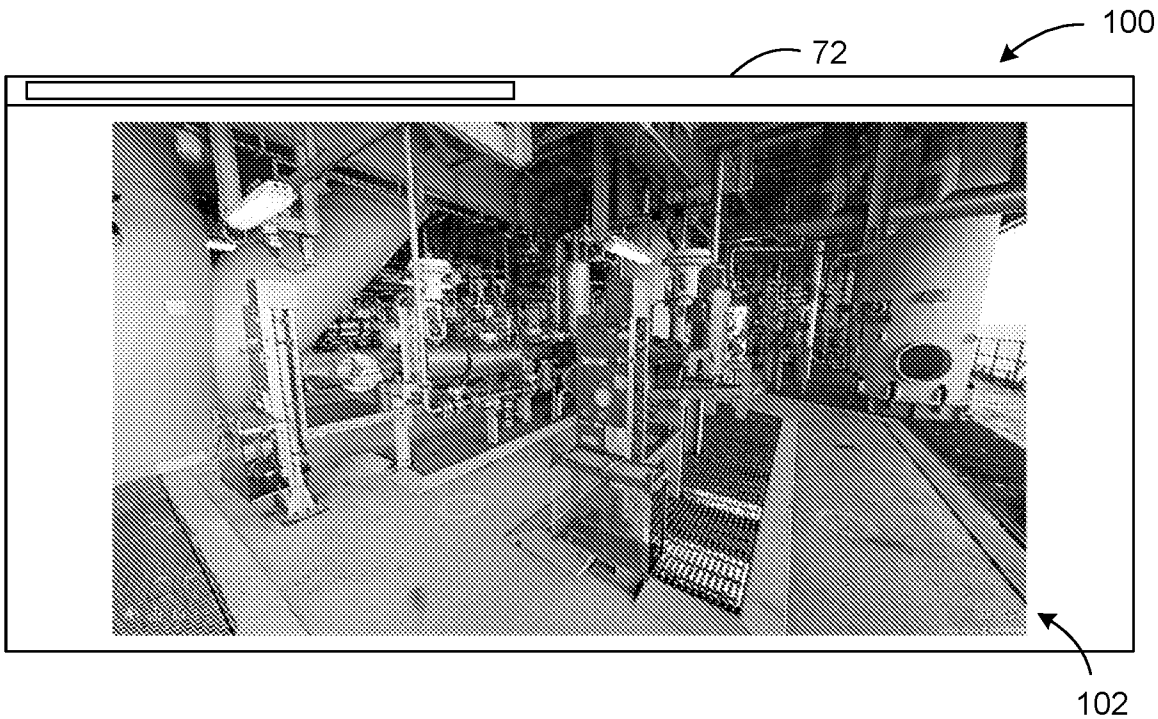

Fig. 9