US 20010015759A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2001/0015759 A1

(43) Pub. Date: Aug. 23, 2001

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(54) LOCATION-INFORMED CAMERA

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(21) Appl. No.: **09/788,568**

(22) Filed: **Feb. 21, 2001**

(30) **Foreign Application Priority Data**

Mar. 20, 2000 (GB) 0006695.3
Feb. 21, 2000 (GB) 0004067.5

Publication Classification

(51) **Int. Cl.**[7] **H04N 5/222**

(52) **U.S. Cl.** **348/232**; 348/333.02

(57) **ABSTRACT**

A camera **(90)** is provided with an arrangement for location-stamping image recordings and with a subsystem for recording location data **(175)** independently of making an image recording. The independently-recorded location data is sequentially associated with the image recordings and can be used subsequently to retrieve corresponding photos from a photo archive **(40)**.

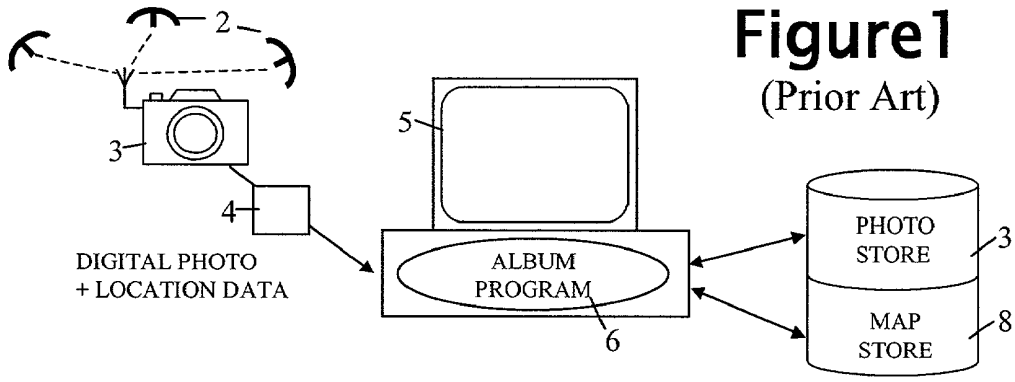


Figure1
(Prior Art)

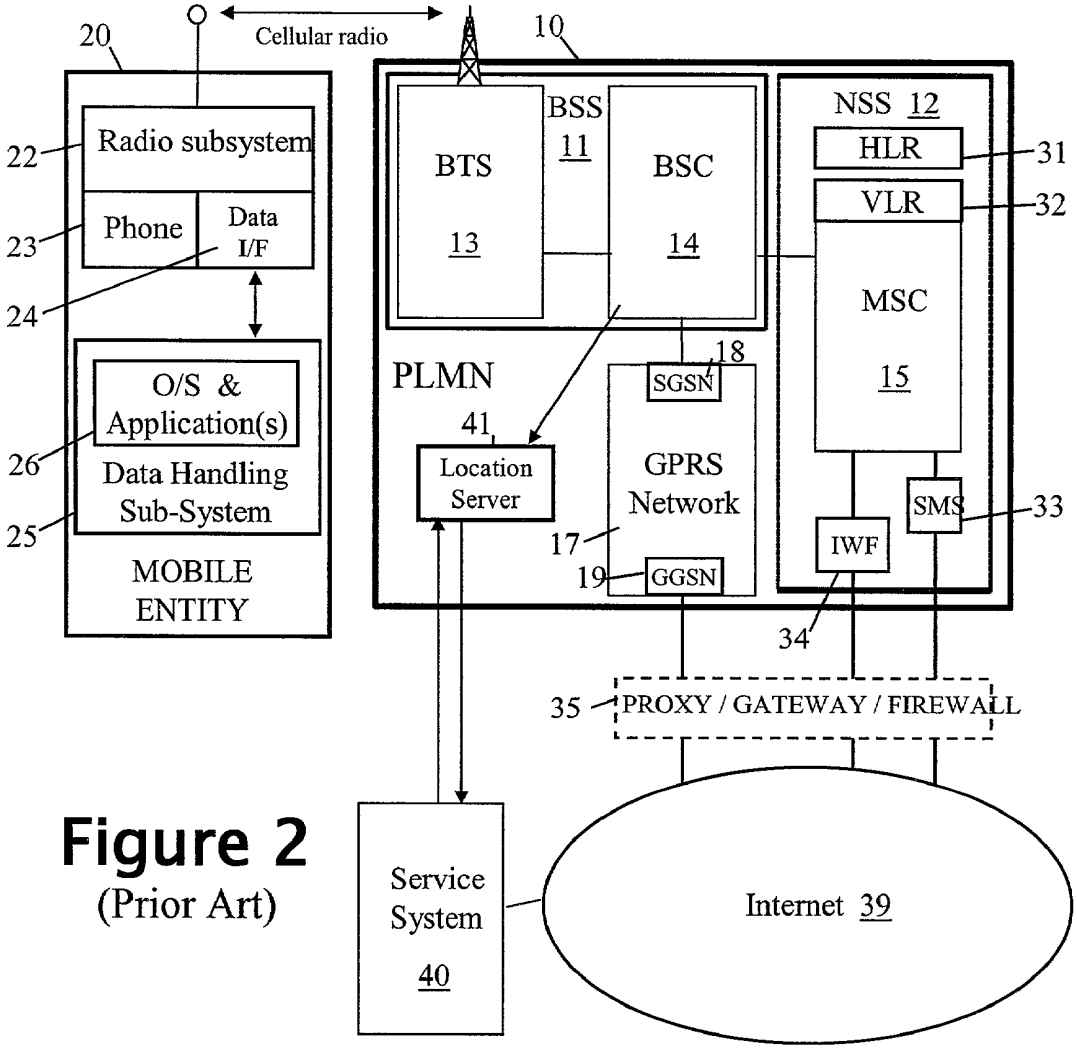


Figure 2
(Prior Art)

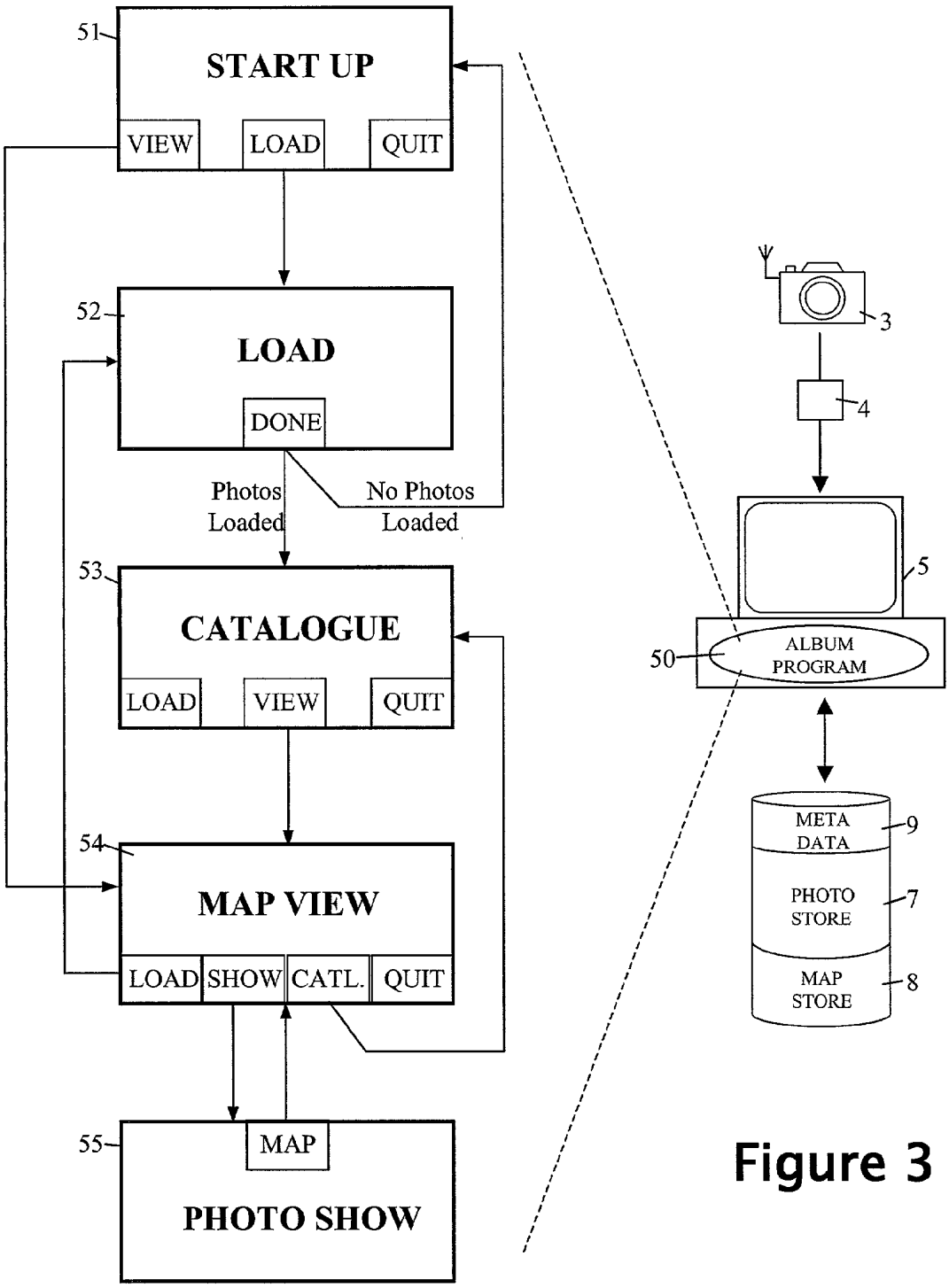

51
START UP
VIEW
LOAD
QUIT
52
LOAD
DONE
Photos Loaded
No Photos Loaded
53
CATALOGUE
LOAD
VIEW
QUIT
54
MAP VIEW
LOAD
SHOW
CATL.
QUIT
55
MAP
PHOTO SHOW
3
4
5
50
ALBUM PROGRAM
META DATA
9
PHOTO STORE
7
MAP STORE
8

Figure 3

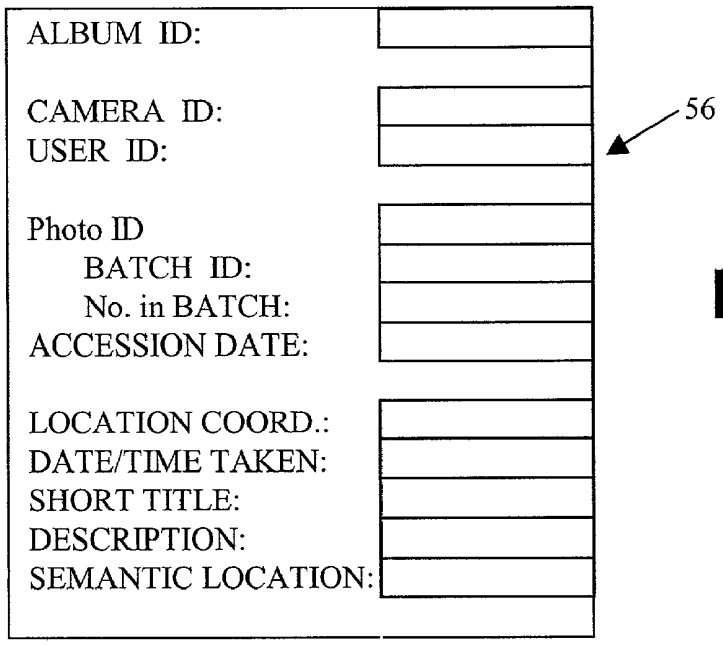
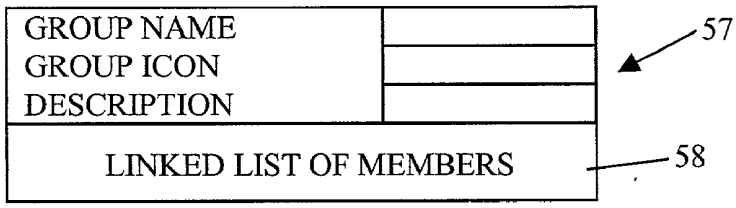


Figure 4



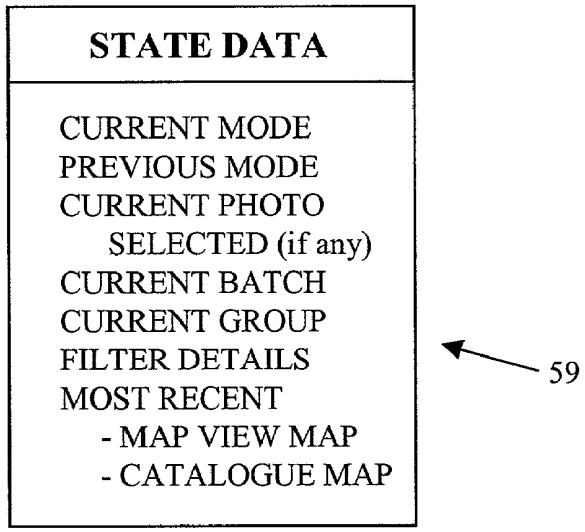


Figure 5

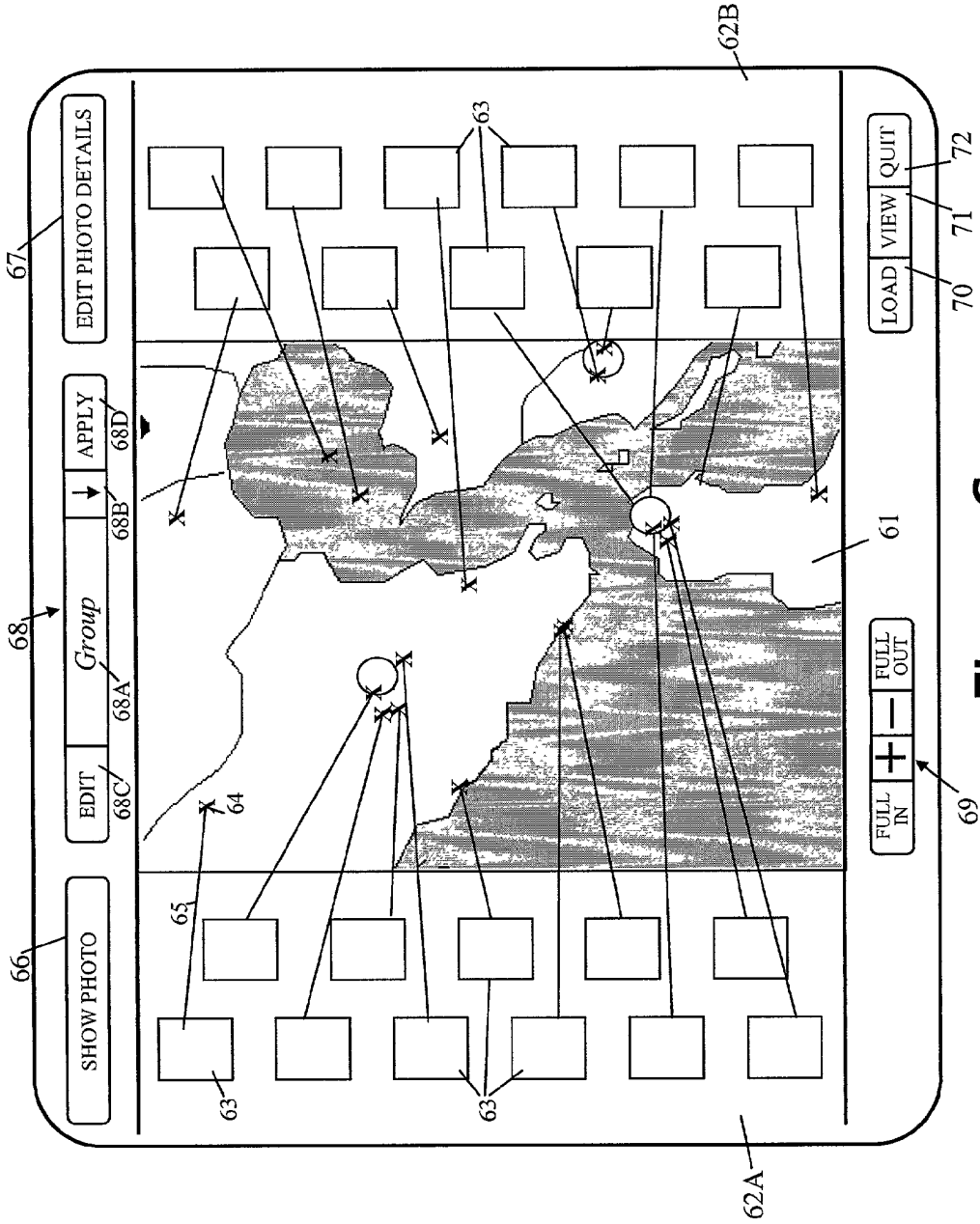

EDIT PHOTO DETAILS
67
APPLY
68D
68B
68
Group
68A
EDIT
68C
SHOW PHOTO
66
64
65
63
63
63
62B
62A
61
LOAD
VIEW
QUIT
70
71
72
FULL IN
+
−
FULL OUT
69

Figure 6

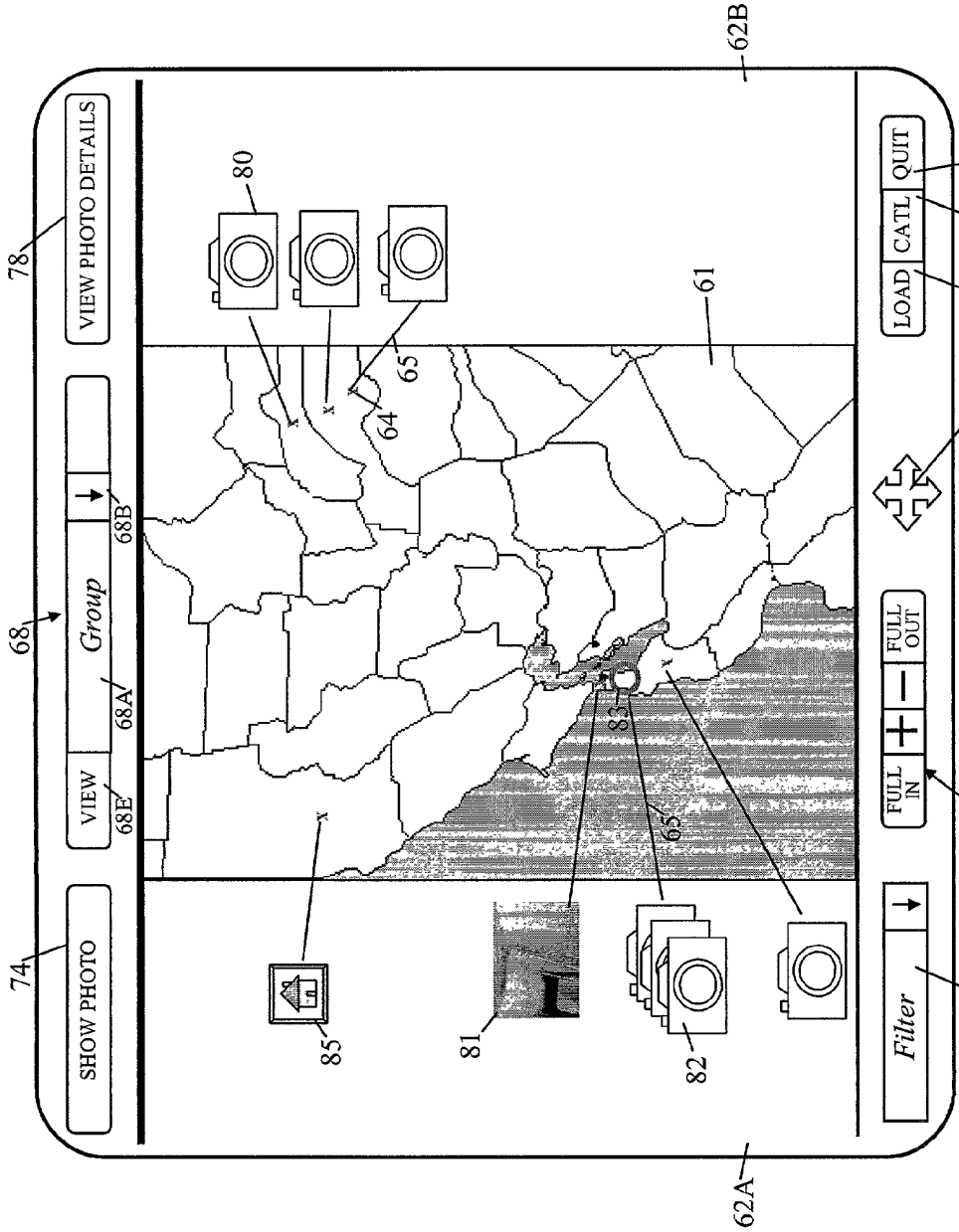

62B
78
VIEW PHOTO DETAILS
80
72
QUIT
73
CATL
LOAD
70
61
65
64
75
68
Group
68B
68A
VIEW
68E
FULL OUT
FULL IN
69
86
65
74
SHOW PHOTO
85
81
82
Filter
76
62A

Figure 7

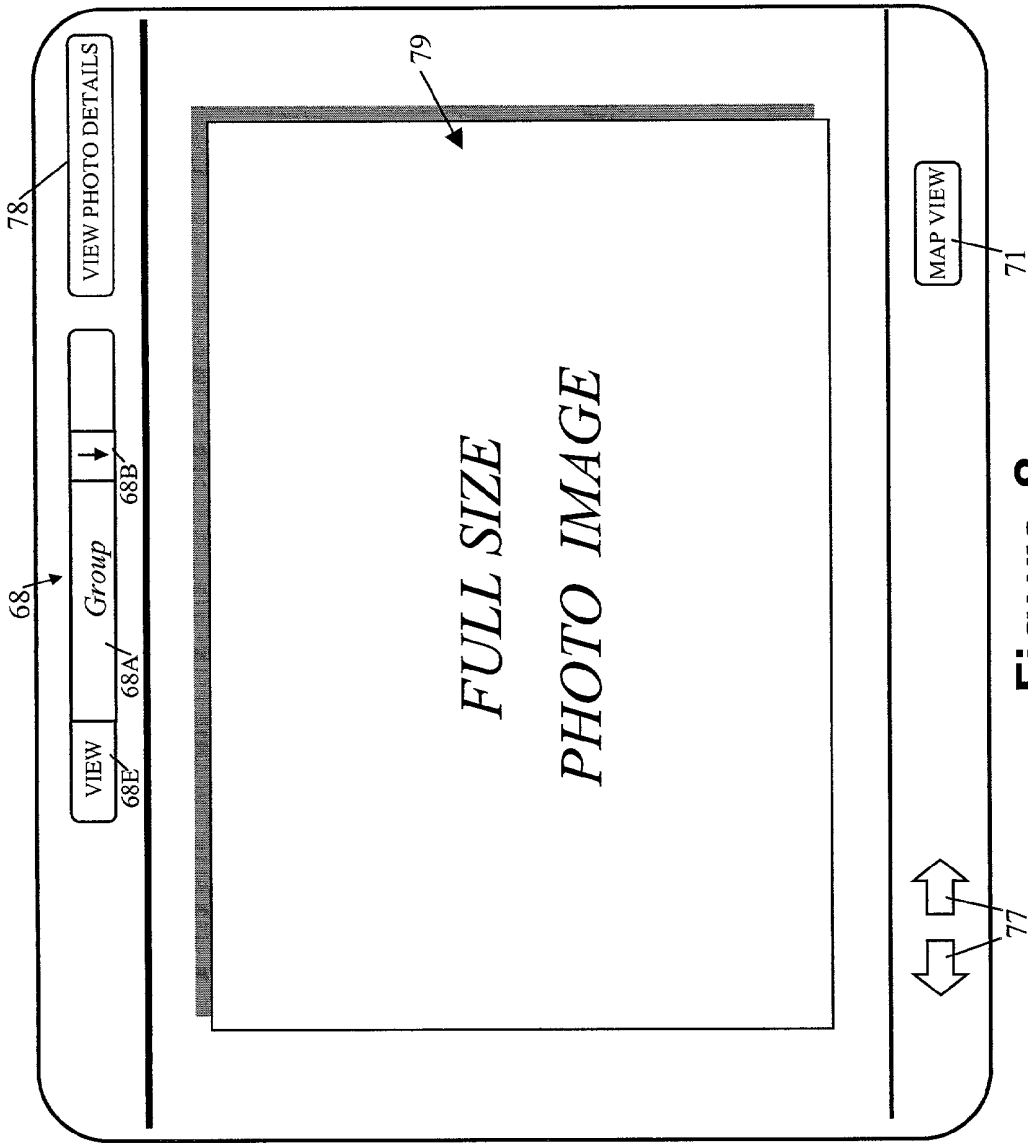

VIEW PHOTO DETAILS
78
68
VIEW
68E
Group
68A
68B
79
FULL SIZE
PHOTO IMAGE
MAP VIEW
71
77

Figure 8

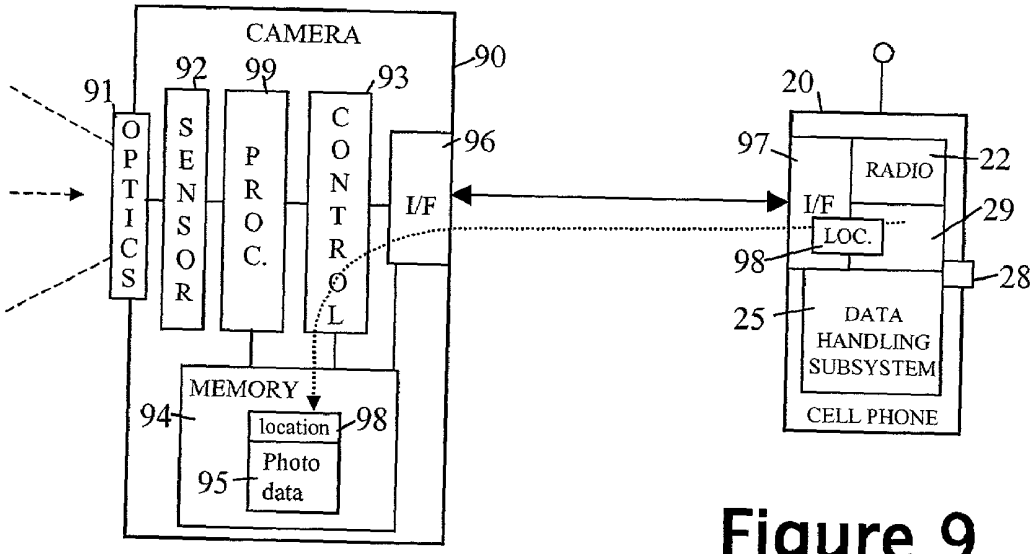


Figure 9

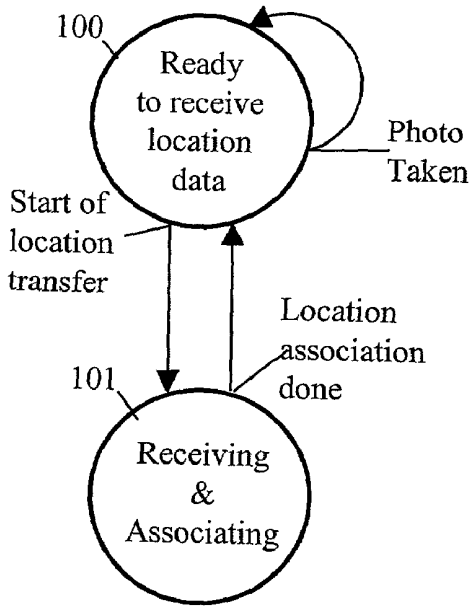


Figure 10

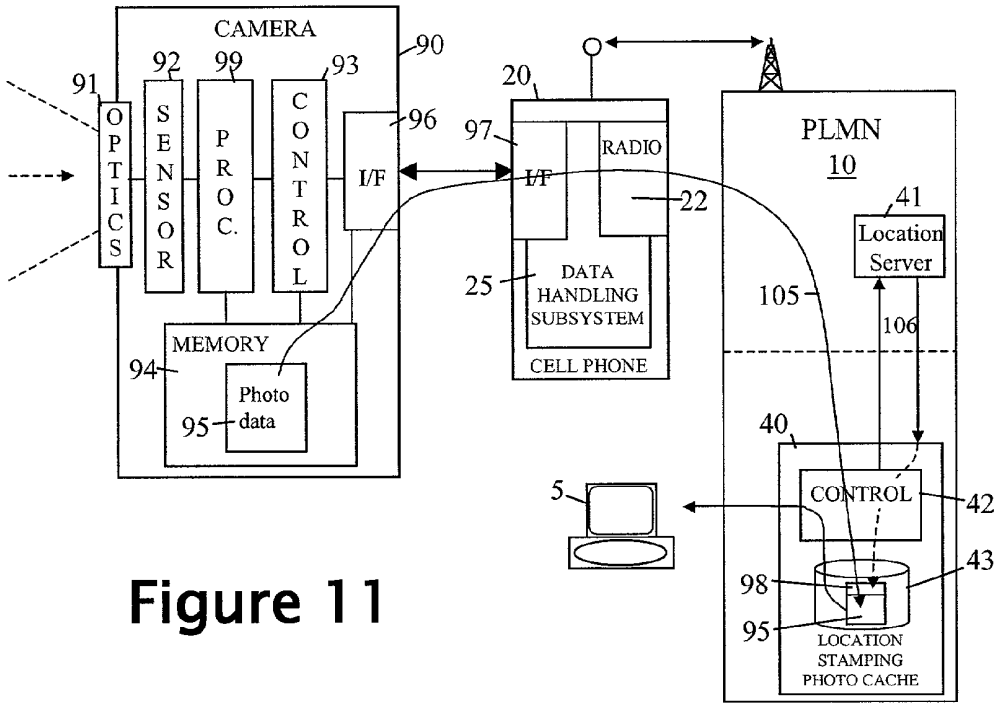


Figure 11

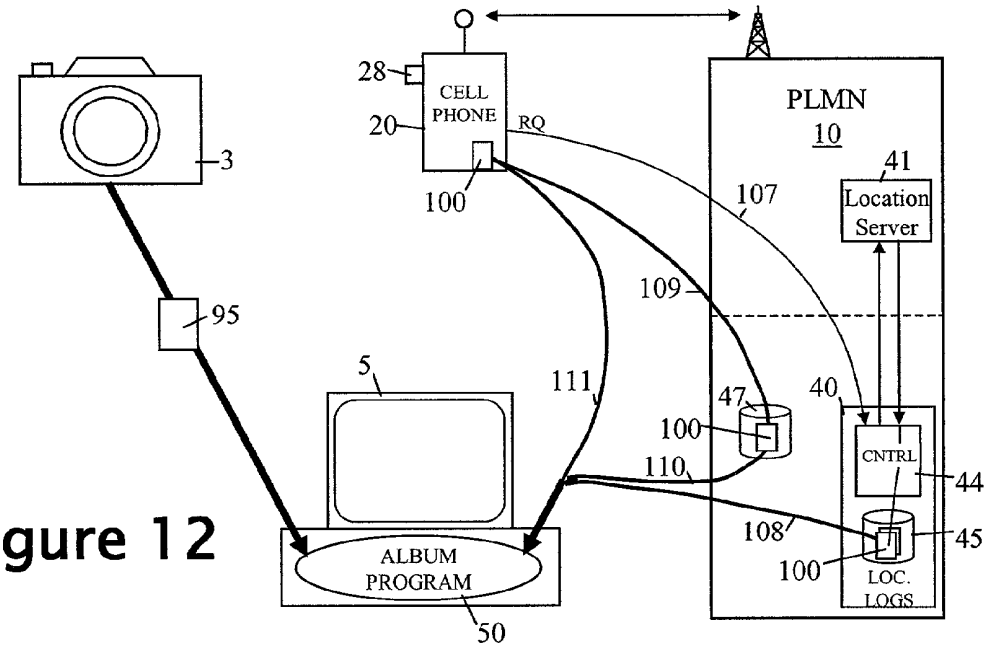


Figure 12

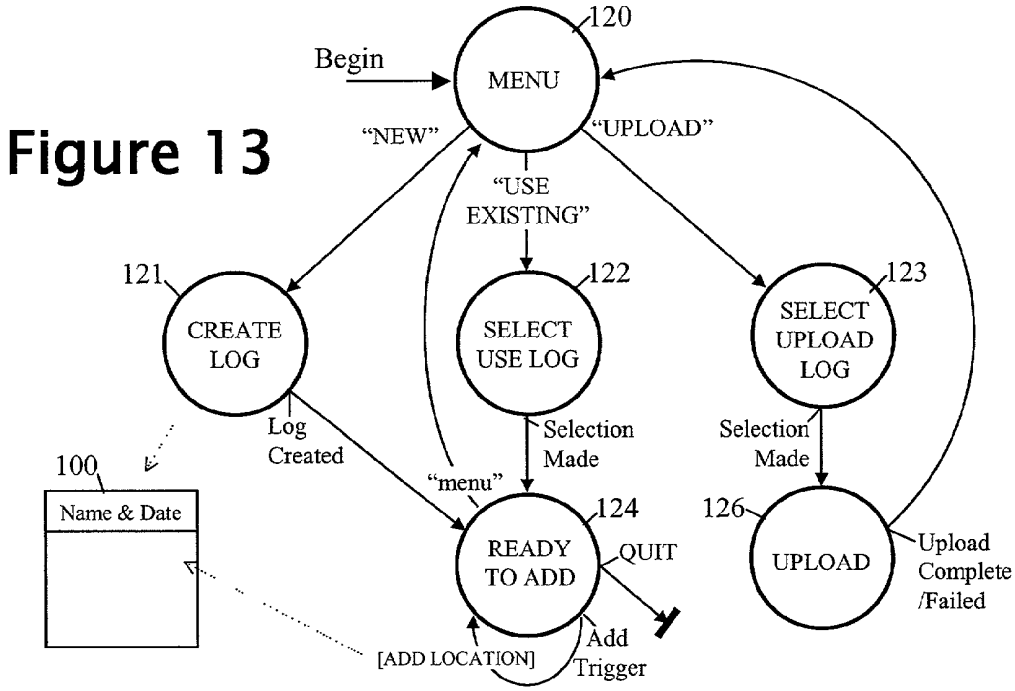


Figure 13

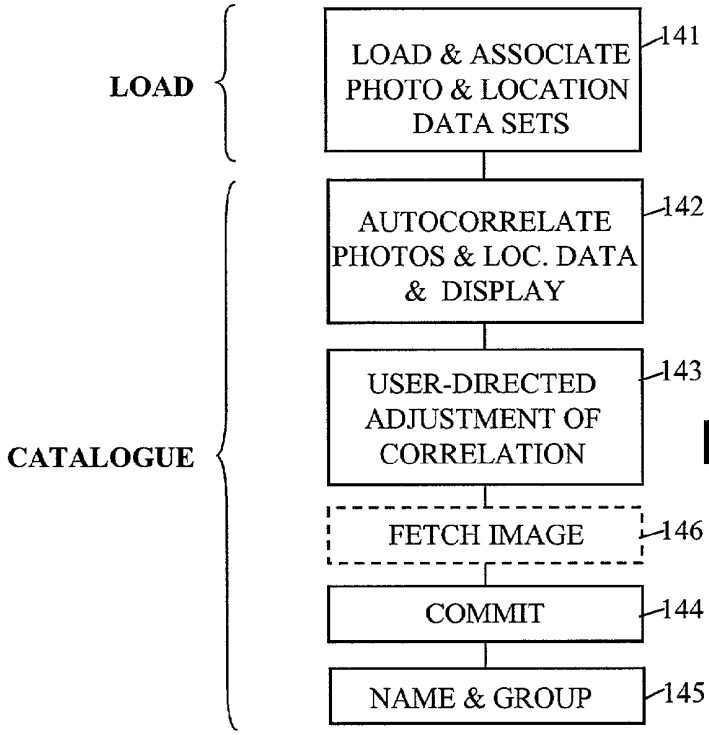


Figure 14

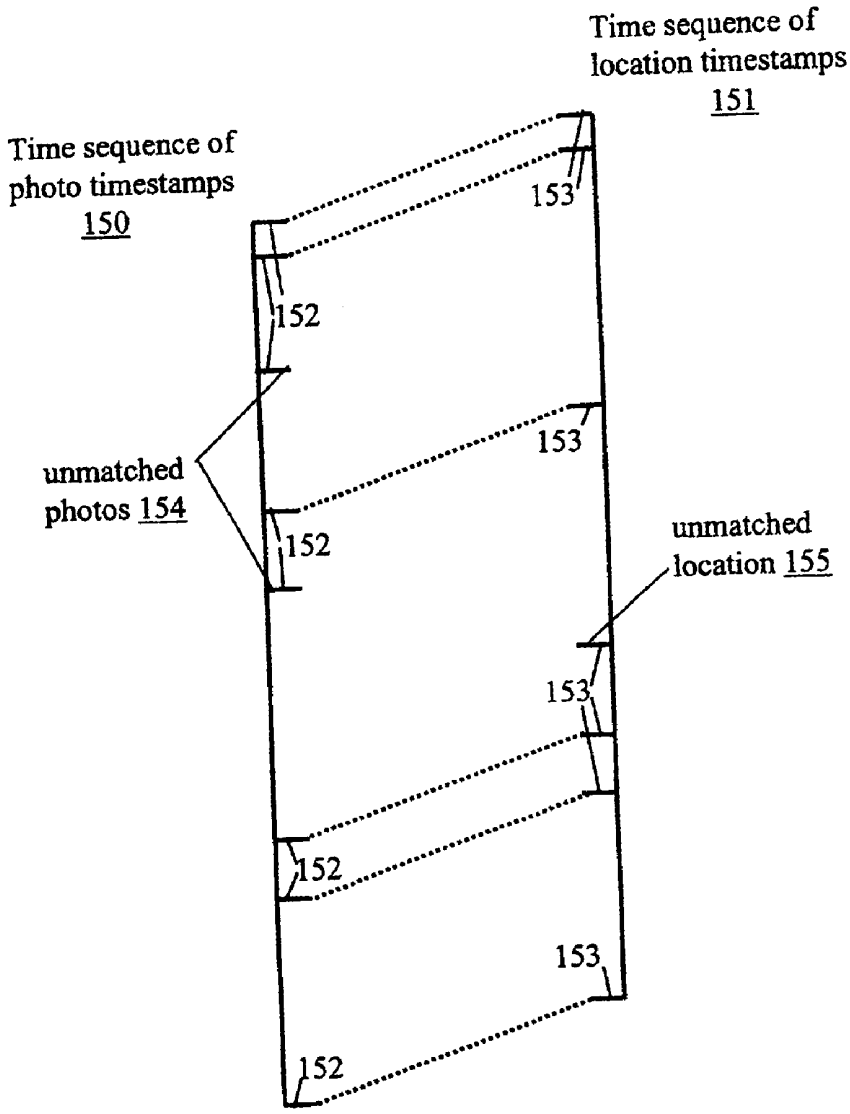

Time sequence of
location timestamps
151
Time sequence of
photo timestamps
150
153
152
153
unmatched
photos 154
152
unmatched
location 155
153
152
153
152

Figure 15

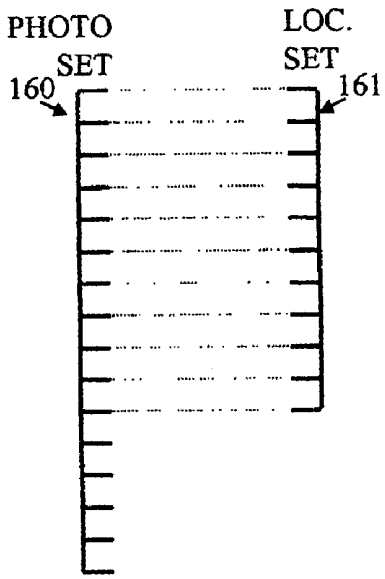


Figure 16A

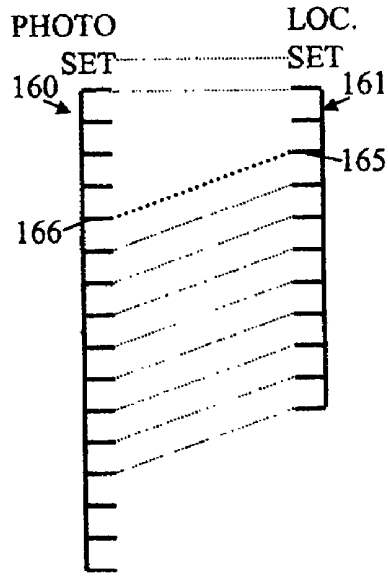


Figure 16B

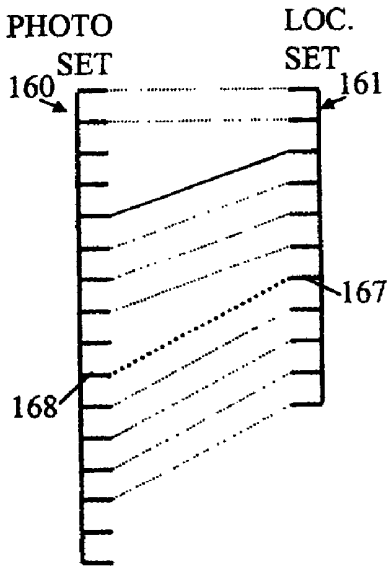


Figure 16C

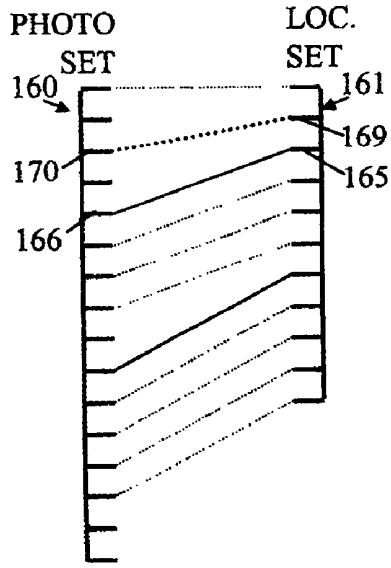


Figure 16D

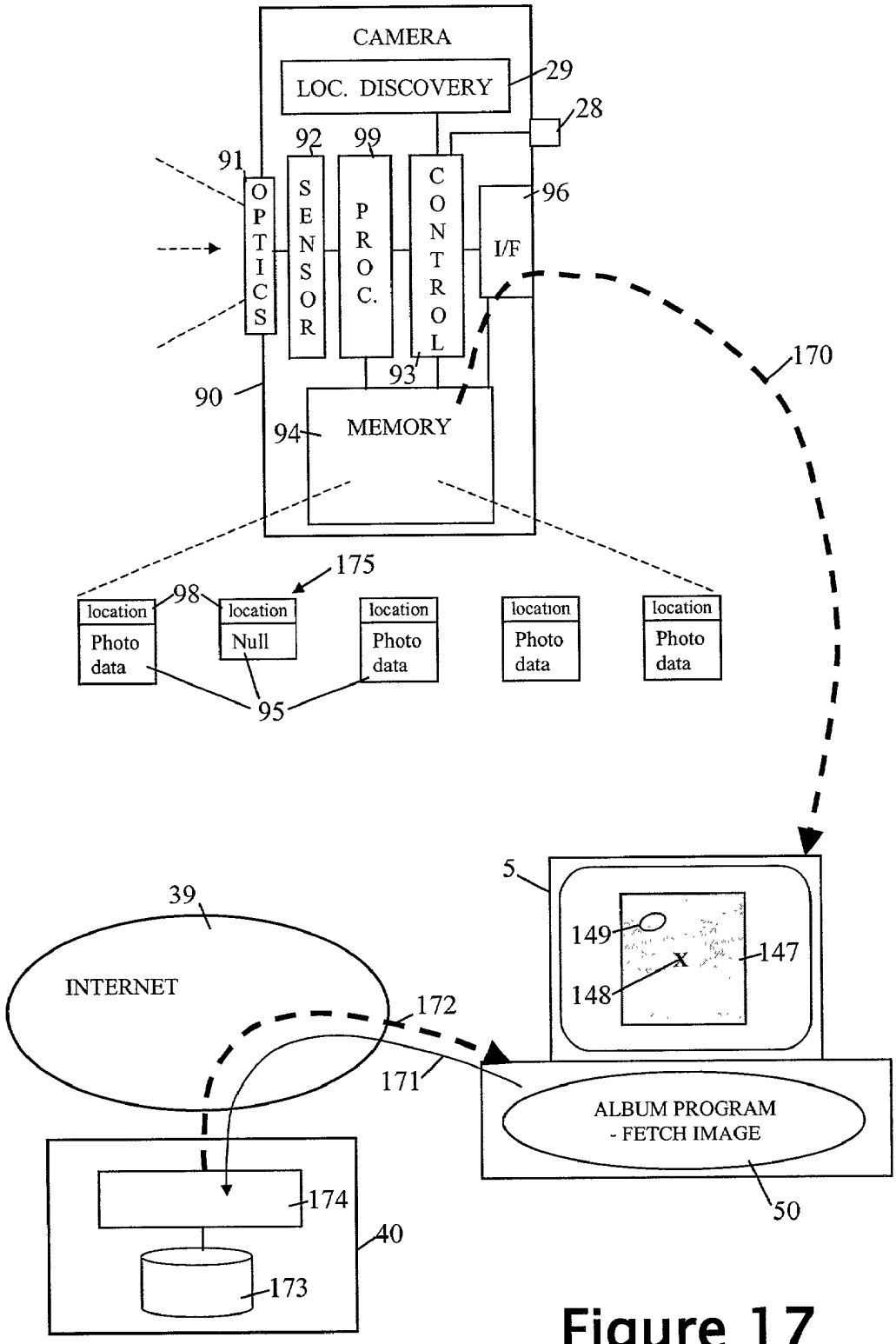

CAMERA
LOC. DISCOVERY
29
28
91
92
99
OPTICS
SENSOR
PROC.
CONTROL
96
I/F
170
90
93
94
MEMORY
175
98
location
Photo data
location
Null
location
Photo data
location
Photo data
location
Photo data
95
5
39
INTERNET
149
147
148
172
171
ALBUM PROGRAM
- FETCH IMAGE
50
174
40
173

Figure 17

LOCATION-INFORMED CAMERA

FIELD OF THE INVENTION

[0001] The present invention relates to a camera which can obtain location data about its current location and associate it with image recordings. As used herein, recording includes image recordings (single photographs, sequences of photographs, and video recordings, all whether chemical or digital), sound recordings, etc.

BACKGROUND OF THE INVENTION

[0002] Classification of photographs, particularly those taken by individuals and families, has long been a problem due to the effort involved in maintaining any organisation of the photos. What is needed is a logical organisation, valid over a lifetime, that requires minimal effort to implement and is intuitive to use when retrieving photos.

[0003] It has been previously proposed to associate location (and orientation) data with digital photos. The location data can be derived in any suitable manner such as from a GPS system or by using information obtained from a cellular radio system. Thus, IBM Technical Disclosure 413126 teaches a digital camera provided with a GPS receiver. U.S. Pat. No. 5,712,679 discloses a locatable portable electronic camera which is arranged to send back image and location data when triggered, the location data being displayed on a map and the image being shown separately. Also of interest is U.S. Pat. No. 5,389,934 which describes a portable locating system with a GPS unit that is operative to store a travel history of locations visited.

[0004] Other proposals go further and disclose the management digital photographs by using an electronic map to show a thumbnail of each photograph at a corresponding position of the electronic map. **FIG. 1** of the accompanying drawings illustrates the main elements for implementing such an system, these element being a digital camera **3** equipped with a GPS receiver for determining camera location using signals from satellites **2**, a PC **5** for receiving digital photographs **4** downloaded from the camera **3** together with GPS-derived location information about where each photograph was taken, an album program **6** for managing the downloaded photographs, a store **7** for storing the digital photographs (plus location information), and a store **8** for storing map data (the stores **7** and **8** will generally be internal to the PC **5** but may by external). Such an arrangement is described, for example, in JP 10233985A.

[0005] The combination of location-tagged digital photographs with map-based digital photograph albums should greatly facilitate the management of photographs for the ordinary user. However, it is important that the photograph management systems provided with the map-based electronic albums are also flexible and easy to use. In this respect the above-mentioned JP 10233985A describes the possibility of the user classifying each photograph whilst JP 8335034A discloses the use of an icon to represent groups of photographs on a map display.

[0006] It is an object of one aspect of the present invention to further facilitate the making of collections of photographs (and other image recordings) by augmenting sets of taken image recordings.

[0007] Certain arrangements described hereinafter utilize data bearer services and location services of cellular radio networks. Such networks are widespread though the aforementioned services are only now being taken up significantly. To facilitate an understanding of the described arrangements, a brief review of cellular network technology and how the foregoing services can be implemented is given in the Annex appearing at the end of this description, reference being had to **FIG. 2** of the accompanying drawing that depicts a mobile location-aware service being provided to a mobile entity **20** via a Public Land Mobile Network (PLMN) **10** .

SUMMARY OF THE INVENTION

[0008] According to the present invention, there is provided a digital camera comprising:

[0009] an image recording subsystem for making image recordings;

[0010] a location-providing subsystem for providing location data items representative of the current location of the camera,

[0011] a location-stamping subsystem for associating with image recordings taken using the image recording subsystem, respective location data items, provided by said location-providing subsystem, that each represent the location of the camera at the time the corresponding image recording was taken, and

[0012] a location recording subsystem for effecting user-triggered recording, independently of the recording of an image recording, of location data items provided by the location providing subsystem, these location data items and those associated with the location-stamped image recordings being recorded in a sequential association with each other.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Embodiments of the present invention will now be described, by way of non-limiting example, with reference to the accompanying diagrammatic drawings, in which:

[0014] **FIG. 1** is a diagram of a known map-based photographic album system;

[0015] **FIG. 2** is a diagram of a known communications infrastructure usable for transferring voice and data to/from a mobile entity;

[0016] **FIG. 3** is a diagram of an electronic photographic album system showing the five operating modes of an album program;

[0017] **FIG. 4** shows the fields of a photo record and group record of the **FIG. 3** system;

[0018] **FIG. 5** shows state data items maintained by the album program of **FIG. 3**;

[0019] **FIG. 6** shows a typical display output during a "Catalogue" operating mode of the **FIG. 3** system;

[0020] **FIG. 7** shows a typical display output during a "Map View" operating mode of the **FIG. 3** system;

[0021] **FIG. 8** shows a typical display output during a "Photo Show" operating mode of the **FIG. 3** system;

[0022] **FIG. 9** is a diagram illustrating the transfer of location data from a cell phone to a digital camera;

[0023] **FIG. 10** is a state diagram for the location-data transfer process of **FIG. 6**;

[0024] **FIG. 11** is a diagram illustrating the transfer of camera image data via a cell phone and a PLMN to a PC running the **FIG. 3** album program, the image data being location stamped with the cell phone location during transfer;

[0025] **FIG. 12** is a diagram showing the independent transfer of image data and location data to a PC running the **FIG. 3** album program;

[0026] **FIG. 13** is a state diagram of a location log function of a mobile entity equipped with location discovery means;

[0027] **FIG. 14** is a diagram illustrating the main steps of the Load and Catalogue operating modes of the **FIG. 3** album program in the case of image data and location data being separately provided;

[0028] **FIG. 15** is a diagram illustrating the matching of location data to images by matching patterns of timestamps;

[0029] FIGS. **16**A-D show a user-effected correction of mismatched sequences of images and location data; and

[0030] **FIG. 17** is a diagram showing the recording of the location of desired but not taken photos and the subsequent retrieval of matching images.

BEST MODE OF CARRYING OUT THE INVENTION

[0031] **FIG. 3** depicts a photo system in which a digital camera **3** provided with location determining means (such as a GPS receiver) is used to generate digital photos **4**, each photo (also referred to as 'image data') **4** being stamped with location data indicating where the photo was taken. Other data may also be associated with each photo, such as a timestamp, a camera ID, and a user ID; such associated data (including the location data) is herein referred to as photo meta data. The photos and their meta data are downloaded by any suitable means (USB connection, removable storage device, etc) into a PC **5** where an album program **50** serves to store the photos in a photo store **7** and the photo meta data in a meta-data database **9** (each photo and its meta data being linked by a suitable key associated with both). The album program also has access to a map store **8**. The stores **7** and **8** and the meta-data database can be on the PC or external.

[0032] The album program enables users to catalogue, manage and view their photos through a map-based interface, the photos being represented on a displayed map by a marker indicating the location they were taken.

[0033] More particularly, the album program comprises five main operating modes **51** to **55** and a user can move between these modes or quit the program by making an appropriate choice (for example, by soft keys displayed on the PC display). **FIG. 3** indicates for each mode the main choices available to the user (for example, the label "View" in Start Up Mode block **51** indicates that the user can choose to change to the View Map Mode **54**. The role of each operating mode is as follows:

[0034] Start Up Mode **51**—This is the initial mode upon start up of the album program and it permits a user to select either the Load Mode or the Map View Mode, or to quit the program.

[0035] Load Mode **52**—In this mode, the user can download data from camera **3**; when the user has finished, he/she indicates this (see the "Done" label) and the mode changes either to the Catalogue Mode **53** if any photos have been loaded, or back to the Start Up Mode **51** if no photos were loaded.

[0036] Catalogue Mode **53**—In this mode, the user can manage newly loaded photos using a map based display, this management including assigning them to one or more groups (sets of related photos). From this mode, the user can move back to the Load mode to load more photos or to the View Map mode for browsing the photo album; the user may also choose to quit the program.

[0037] Map View Mode—The Map View Mode **54** is the mode in which a user can browse the album and select photos for viewing. Browsing is on the basis of displaying maps with the location of photos indicated. From the Map View **54**, a user can move to the Load, Photo Show, or Catalogue Modes or quit the program.

[0038] Photo Show Mode—In this mode, the user can view a photo selected in the Map View Mode; the user can also step through a series of related photos. From the Photo Show Mode, the user returns to the Map View Mode.

[0039] **FIG. 4** shows the meta data record **56** held in database **9** for each photo, it being appreciated that some of the fields may be empty for any particular photo. The fields comprise:

[0040] Album ID—This is a unique identifier for the album.

[0041] Camera ID—This is a camera identifier that may be either supplied automatically by the camera in the photo meta data or added by the user when downloading photos.

[0042] User ID—This is a user ID which again may be either supplied automatically by the camera in the photo meta data or added by the user when downloading photos

[0043] Photo ID—This is a unique photo ID provided by the album program and can conveniently be made up of a load batch number (a new batch number being assigned for each session of downloading data from a camera) and a number-in-batch identifying the photo from others in the same batch.

[0044] Accession Date—This is the data of loading of the photo by the album program (photos in the same batch will have the same accession date).

[0045] Location Data—The location data provided with the photo by camera **3**.

[0046] Date/Time Taken—The timestamp data provided with the photo by camera **3**.

[0047] Short Title—A short descriptor of the photo provided by the user.

[0048] Description—A fuller user-provided description of the photo.

[0049] Semantic Loc.—A user-meaningful location description (e.g. Eiffel Tower) as opposed to the coordinates provided by the location data. This field overlaps in intent with the two preceding fields and is optional.

[0050] With respect to user ID, where this is supplied automatically by the camera, the user ID will have been set into the camera at some stage by the user. The camera can be provided with suitable means for enabling each of several users to set in their ID at every usage and/or the means for enabling several different users to set in and store their IDs with each such user selecting their ID from the stored IDs each time that user starts to use the camera; input of ID data can conveniently be done by transfer from a computer thereby avoiding the need for an input keypad associated with the camera. Alternatively, the camera can be pre-programmed with a set list of identifiers (numbers, icons, colours, animal types, etc) and users choose which identifiers to employ to distinguish amongst them; in this case, the camera simply needs to be provided with input means for enabling a user to select their identifier from the programmed list of identifiers. Thus, a camera intended for family use may have pre-programmed animal icons as identifiers with the mother and father choosing, for example, icons of a dog and cat and their three children choosing lion, tiger and rabbit icons respectively. Of course, to handle cases where icon identifiers are used, the album program is preferably adapted to store and manage user IDs of this form.

[0051] The database **9** also holds group records **57** each relating to a group of user associated photographs. Each group record comprises a group name, an indicator of a group icon to be used to represent the group, a brief description of the group, and a linked list of the IDs of photos making up the group. A photo can reside in non, one or more group.

[0052] **FIG. 5** shows the main state data items **59** maintained by the album program so that it knows what operational point it has reached and how to restore itself to certain prior conditions as necessary. These data items comprise:

[0053] Current Mode—The current operating mode.

[0054] Previous Mode—The previous operating mode, if any. This is required when about to enter the Map View mode from the Catalogue Mode—if the user is merely returning to the Map View Mode after having gone into the Catalogue Mode (for example, to change meta data about a photo), then the user will expect to reurn to the same map and display as before whereas if the user is entering the Map View Mode from the Catalogue Mode after having catalogued a newly loaded set of photos, the user will have different expectations.

[0055] Current Photo—This is the currently selected photo, if any. The selected photo may be one currently be displayed in full or merely represented by an icon or thumbnail.

[0056] Current Batch—The batch number of the current batch of photos or, where photos from more than one batch are being examined, then the batch number of any currently selected photo.

[0057] Current Group—The currently selected group, if any.

[0058] Filter Details—Details of any filter being applied to the selection of photos in the Map View and Photo Show Modes.

[0059] Most recent:

[0060] Map View map—The most recently viewed Map View Mode map (including area displayed)

[0061] Catalogue map—The most recently viewed Catalogue Mode map (including area displayed)

[0062] Other features of the album program will be described below as part of the description of a typical sequence of operation.

[0063] A user with photos to download to the album program starts the program and chooses the "Load" option presented by the Start Up Mode program code. The Load Mode interacts with the user to enable the downloading of photos and meta data from the camera **3**, photo ID data (Batch and number-in-batch) and accession date being automatically added by the program to the meta data of each photo. The user may also be enabled to add in user ID data for the whole batch, overriding any such data coming from the camera. Upon termination of loading, the user selects "Done" and the album program automatically progresses to the Catalogue Mode to enable the user to carry out cataloguing functions in relation to the newly-loaded batch of photos.

[0064] In the Catalogue Mode, the album program generates a display of the form shown in **FIG. 6** comprising a central map area **61**, left and right margin areas **62**A, **62**B and upper and lower control bars. The map displayed in map area **61** is sufficient to encompass the locations registered for the newly loaded batch of photos. A thumbnail **63** of each new photo is shown in one or other of the margin areas **62**A, B and a lead line **65** connects each thumbnail **63** to a corresponding marker **64** showing on the map the location where the photo was taken. The use of margins to show the thumbnails and lead lines to indicate the corresponding map locations is preferred as being less cluttered than trying to place the thumbnails directly in the correct locations on the map.

[0065] The upper control bar comprises three controls **66**, **67**, **68** that provide access to the following functionality, generally in respect of a pre-selected photo (this pre-selection being effected by clicking on the corresponding thumbnail):

[0066] Show Photo Control **66**—this displays the photo corresponding to a selected thumbnail **63**, with return to the Catalogue map being effected by a mouse click;

[0067] Edit Photo Details Control **67**—this displays the record details **56** of a selected thumbnail and enables editing of these details;

[0068] Group Control **68**—this control permits groups to be created, and a photo to be assigned to one or more groups (the photo ID being added into the group record **57**).

[0069] The group control comprises a drop-down box **68**A operated by control element **68**B, the box normally displaying a currently selected group, if any. The user may cause the box to drop down (by clicking on control element **68**B) to show a list of available groups from which the user can select one, this list also including an option to create a new group. Selecting this latter option takes the user to a creation screen where the user enters details of the new group. The details of a currently selected group can also be brought up for editing by operating (clicking on) control element **68**C. To assign a photo to the current group, the corresponding thumbnail is selected and then the "Apply" control element **68**D is operated. Preferably, double clicking the "Apply" control gives the mouse cursor the "Apply" power so that any thumbnail selected using the cursor is assigned to the current group (clicking on the Apply element again removes this power).

[0070] By way of example, a user may decide to create a group for photos taken on a particular holiday or a group for all photos related to a current or past abode. The group icon can be selected from a set of available icons or created by the user. Thus a current-abode group may have a house icon as its group icon whilst a holiday in London may be represented by a Tower Bridge icon.

[0071] The lower control bar includes a zoom control **69** that enables a user to zoom in or out around a particular point on the displayed map. More particularly, to zoom in on a target point, the "+" element of control **69** is selected, the display cursor placed on the target point and clicked. The "+" and "−" elements effect stepped, progressive, zooming; in contrast, the "Full In" element goes straight to closest zoom on a target point whilst "Full Out" returns to the original map display encompassing all of the newly loaded photos.

[0072] Controls **70**, **71** and **72** respectively enable a user to change to the Load Mode, change to the Map View Mode, and Quit the program.

[0073] The album program is preferably operative to accept photos for which there is no meta data, including no location data. In this case, the corresponding meta data record initially only contains the album-generated data (Photo ID, accession data), and the Catalogue Mode is arranged to represent these photos but without lead line or location marker until such a time as the user enters location data into the location field of the photo record **56** either directly or by a facility for adding this data by pointing to a location on the map display.

[0074] Once a user has finished editing the photo meta data and assigning the photos to groups, the user may decide to browse the album and accordingly operates the "View" control **71**. **FIG. 7** depicts a typical Map View Mode display; for ease of understanding, the same references have been used on corresponding elements appearing in the Catalogue Mode and Map View Mode.

[0075] The starting map displayed in the Map View Mode is, for example, a world map or a map encompassing the locations of all the photos recorded in the album; alternatively, the map displayed could be the same map as being used in the Catalogue Mode before transiting to the Map View Mode. Initially, all photos relevant to the starting map will be represented either as thumbnails **81**, individual photo icons **80**, group icons (see current-abode group icon **85**), or concentration icons (see icon **82**). A concentration icon represents a number of photos that are not in a common group but were taken in the same general area and cannot be individually represented at the current map display resolution; the area concerned can be represented by a bounding circle **83**. Where a concentration icon only encompasses photos that belong to a common group, the concentration icon is replaced by the group icon. Similarly, where a concentration icon encompasses at least a threshold number (e.g. **5**) of photos that belong to a common group but other photos as well, then the group icon is shown alongside the concentration icon. If the threshold is crossed for several groups then each group icon will be shown (in determining whether the threshold is crossed, if a photo belongs to more than one group, it is counted towards the threshold for each group).

[0076] Zooming in and out is controlled by the same control **69** as already described for the catalogue Mode. If zooming in permits the photos of a concentration to be represented individually then this is done, the photos being collapsed back to a concentration icon and/or group icon on zooming back out. Scrolling the map display left, right, up or down is effected by scroll control **75** (or else scroll bars can be used).

[0077] To minimise clutter, a user may set an option (through a "customise menu", not shown) by which all photos of a group are initially represented by the corresponding group icon even if there is room to display the thumbnails of the group photos encompassed by the currently displayed map. In this case, the group icon is displayed with its location marker at the location of a user-specified one of the photos of the group (to implement this, a further group-control element "set leader" can be provided which, when activated, would store the photo ID of a currently-selected photo into an extra field of the group record of the current group, the location of this photo being the "location" of the group). To give access to the individual photos of a group, one or both of the following mechanisms can be used:

[0078] Single clicking on a group icon brings up a scrollable list of the photos in the group (preferably with date taken information and short title). Mouse rollover of a photo entry in the list causes the location marker of that photo to be displayed on the Map View (the photo's thumbnail can either be shown in the scrollable list all the time the list is displayed, or adjacent its location marker but only whilst the latter is displayed); moving the mouse cursor off the entry causes the location marker to disappear. Clicking the list entry causes the thumbnail to be inserted into a margin area with a lead line to a corresponding location marker on the map, this thumbnail being retained following closure of the group photo list. A variant of the above is to have display of the list accompanied by display of location markers for all the group photos encompassed by the current map—rollover of a list entry would then highlight the relevant location marker.

[0079] double clicking on a group icon unpacks the group and causes its photos to be represented as individual photos (or in concentrations).

[0080] Generally, whenever a particular photo is selected (for example, by clicking on it) the name of the related group (if any) is displayed in the group control element **68**A—if a photo belongs to more than one group, these groups are viewable by opening up the dropdown box using control **68**B. The details of the selected photo can then be viewed (but not edited) by operating control **78** or the photo viewed by operating Show Photo control **74** which causes the mode to switch to the Photo Show Mode. The details of the current group, if any, can be viewed by operating the view group control **68**E.

[0081] Filter control **76** enables a user to select which photos are to be represented on the map display. Selection criteria can, for example, include one or more of the following:

[0082] Date range of when the photo was taken;

[0083] User ID

[0084] Camera ID

[0085] Group name

[0086] Batch ID

[0087] Accession date

[0088] Key word in short title/description/semantic location.

[0089] Access to a particular's user's photos can be password protected

[0090] If the user wishes to edit the details of a photo or group, the user must select the relevant photo and return to the Catalogue Mode; the map and photos displayed in the Catalogue will be those of the same batch as the selected photo.

[0091] **FIG. 8** shows the Photo View Mode display brought up by clicking the Show Photo control **74** in the Map View Mode when a photo is selected. A full size image **79** of the photo is displayed and the user can view the photo and group details using the controls **67** and **68** respectively. Furthermore, a control **77** permits the user to view related photos in the same group (if photo is in more than one group, this will be the group appearing at the top of the dropdown box **68**A, a different group being selectable by dropping down the group list); the group photos are accessed, for example, in date/time of taking order. If a photo is not associated with a group, then the album program permits photos of the same batch to be viewed, ordered by number.

[0092] The provision of suitable program code for implementing the above-described event-driven functionality is within the competence of persons skilled in the art.

[0093] A similar map-based album to that described above can also be used to classify and access other types of recording such as sound recordings, video recordings etc. Where the data is non-visual, the thumbnails and full-sized photo image representations of the above-described electronic photo album will be replaced by the corresponding representations for the recording concerned.

[0094] Uniting Location and Recording Data—at the time of generation

[0095] Of course, the vast majority of current cameras are not provided with location determining means. Nevertheless the foregoing map-based album can still be built up provided the user can activate a location determining device whilst located at the place a recording is being/has been/is about to be, made. In the near future, many location-determining devices (such as GPS devices) will be widely deployed; potentially more significantly, location services will become widely available to users of mobile phones (see the Annex to this specification which describes the mobile radio infrastructure and the provision of location-based services using such an infrastructure).

[0096] Thus it will become relatively easy for someone taking a photo to find out their location using their mobile phone. However what is additionally needed is some way of uniting this location information with the photographs.

[0097] One way of doing this is illustrated in **FIG. 9** where a digital camera **90** is provided with a communications link to receive location data from a mobile entity **20** (here shown as a mobile phone, by way of example). More particularly, camera **90** comprises optics **91**, sensor array **92**, image processing block **99**, control block **93**, memory **94** for storing photo image data **95**, and a communications interface **96**. Cell phone **20** comprises, as well as its radio subsystem **22**, a data handling subsystem **23**, and communications interface **97**. Interfaces **96** and **97** are compatible, enabling the camera **90** and cell phone **20** to intercommunicate; interfaces **96** and **97** are, for example, suitable for establishing an infrared or short-range radio link between the camera and cell phone.

[0098] Cell phone **20** also includes location-discovery means **29** by which the cell phone can ascertain its location, this location discovery being effected when control **28** (hard or soft button) is operated by the user. The location discovery means is, for example, a program run by the data handling subsystem for requesting location information from a location server of the mobile radio infrastructure; however, the location discovery means could alternatively be a GPS system built into the cell phone. Whatever form the location discovery means takes, when button **28** is operated, location data **98** is generated and is available in the phone for transfer to the camera **3**.

[0099] The data handling subsystem runs a transfer program for transferring the location data over a link establish between the interfaces **96**, **97**. The control block **93** of the camera is operative to receive this location data and associate it with the last-taken photo. **FIG. 10** shows a top-level state diagram of how this process is managed by association functionality of control block **93**. Normally the association functionality resides in a state **100** in which it is ready to receive location data through interface **96**; whilst in this state, the camera can be used to take photographs and the association functionality remains in state **101**. However, upon location data being passed from cell phone, the association functionality transits to state **101** in which the camera is blocked from taking a photograph. In state **101**, the association functionality of control block **93** receives the location data and associates it with the last taken photo. Once this is done (and it generally will happen very rapidly) the association functionality returns to state **100**.

[0100] Of course, it would also be possible to have the taking of the photo by camera **90** trigger the location discovery by the cell phone followed by transfer to the camera.

[0101] Another way of uniting a digital photo and location data is illustrated in **FIG. 11** and involves uploading the photo image data **95** through the cell phone (via a link established between camera **90** and cell phone **20** through interfaces **96** and **97**), to a network store **43** of a service system **40** (arrow **105** represents this transfer). The service system **40** resides either in the mobile infrastructure or is accessible via the latter over a data-capable bearer service. En route to the store, or upon loading into the store, location information **98** on the mobile phone is requested and associated with the photo image data **95**; in the first case, the location data is obtained by the cell phone and associated with the image data as the image data is being transferred to the store **43** whilst in the second case, a control function **42** of the store is operative to request the location data **98** from location **41** immediately upon the image data being received by service system **40**. Of course, this method will generally need to be effected for each photo immediately it is taken since otherwise the location of the cell phone may not correspond to the location where the photo was taken.

[0102] The foregoing methods of associating separately generated image and location data at around the time of generation can equally be applied to other types of recording.

[0103] Uniting Location and Recording Data—subsequent to when generated

[0104] In many cases, it will not be possible, for whatever reason, to link the camera **90** with a cell phone or other available location discovery means (such as a stand-alone GPS device). For these cases, a location log can be created for subsequent correlation with the photos being taken. More particularly,

[0105] as the camera is used to take a number of photographs, the photographs as items are distinguished from each other by an implicit (e.g. sequence position) or explicit location-independent reference associated with each;

[0106] in association with taking each of at least some of said photographs, a mobile device that is separate from the camera and is capable of effecting or triggering location discovery of its position, is used to generate location data indicative of the location at which the photograph was taken, this location data being stored together with an index matching the reference associated with the corresponding photograph;

[0107] subsequently, the location data is united with the corresponding photographs by a correlation process using said references and indexes.

[0108] The mobile device is, for example, a cellular-radio-based mobile device (phone or e.g. a PDA with mobile radio capability) capable of effecting location discovery such as by requesting location data from a location server; the mobile device may take other forms such as a standalone GPS device.

[0109] References can simply be position-in-sequence of photographs (in which case the corresponding indexes are similar ordering data). Alternatively, the references can be timestamps—in this case, the indexes could be timestamps also (or, again, ordering data since timestamps are also this).

[0110] The photos can be traditional (chemical) snaps and the uniting is done by printing labels with the location data, these labels then being stuck on the back of the snaps (preferably this location data takes the form of a map showing the location where the photo was taken)—in this case, the labels are numbered to correspond to photo numbers.

[0111] Preferably, however, the photos are digital (or digitised) and the uniting of the photos with the location information is done in a PC or other computing device as part of the album program. Processes for effecting this uniting will be described hereinafter.

[0112] With regard to how the location data is transferred to the same computing device as the photo image data, a number of possibilities exist and **FIG. 12** illustrates three such possibilities in the case where the mobile device is a cell phone **20**. More particularly, **FIG. 12** shows a camera **3** and cell phone device **20** both possessed by the same user. The cell phone **20** communicates with mobile radio infrastructure **10**. Whenever a user takes a photo he/she operates a button **28** of the cell phone to cause the cell phone to trigger a determination of its location either by itself or through location server **41** of the PLMN **10**. A log of location data on each photo taken is built up. In due course the user transfers the image data **95** from the camera **3** to computer **5** running the album program **50**. As regards transfer of the location log to the computer, the following three possibilities are illustrated:

[0113] a)—location data for each photo is accumulated in a location log **100** stored in the cell phone and subsequently transferred (see arrow **111**) directly to the computer **5** over a wire link, infrared link or short-range radio link.

[0114] b)—location data for each photo is accumulated in a location log **100** stored in the cell phone and this log is subsequently transferred (arrow **109**) via a data-capable bearer service of the PLMN **10** to a store **47** (in the PLMN or a connected network, such as the Internet). The location log is later retrieved by computer **5** from store **47** (see arrow **110**).

[0115] c)—Operation of cell-phone button **28** sends a request (arrow **107**) to a log-service controller **44** of a log server system **40** to obtain the location of cell phone from location server **41** and store it in a log **100** held in store **45** of the service system, the identity of the log to be used being included in the request. The log **100** is subsequently retrieved by computer **5** from store **45** (see arrow **108**).

[0116] The same processes as described above can being effected for other types of recordings, the location data being separately determined and subsequently re-united with the recording concerned. In the case of a sound recording done, for example, on a tape recorder, the location data could even be provided by a digital camera equipped with GPS.

[0117] It may be noted that giving a mobile phone the ability to store a location log (either in the phone itself or in the mobile infrastructure or in a connected network) is itself a useful feature. Thus whilst many location-based services simply require a one-off provision of location data or continually monitor location, the ability for a user to selectively

trigger location determination for storing the resultant data to a log has value in its own right—for example, a user may wish to store the location of places visited whilst out walking or, as described above may want to log the locations of photos taken. Since the user may also want to use other location-based services at the same time, the user must be able to select when location information is to be logged. Further, since the user may want to log location information about different topics, the mobile phone (or other location-determination-triggering device) preferably permits a user to set up more than one log at a time and to select to which log a particular item of location data is to be stored.

[0118] **FIG. 13** shows a controlling state machine for a location-log application capable of managing multiple location logs, the application running, for example, on a data handling subsystem of a mobile entity (such as a cell phone) that has means for discovering its location either directly or from a location server. Selection of the application sets the application into a menu state **120** that presents the user with the choices of creating a new log, using an existing log ,or uploading an existing log (for example, to network store **47** or computer **5** in the **FIG. 12** arrangement). If the user chooses to create a new log, state **121** is entered in which the user is asked to specify certain details about the log (in particular, its name); in due course new log **100** is created and the log application automatically transits to state **124** in which location can be added to the log. This same state **124** is also reached when the user chooses the 'use existing log' option from the opening menu, the log application first entering state **122** in which the user selects from a list of existing logs, the log to be used; selection of the log to be used automatically moves the log application to state **124**.

[0119] When in state **124**, the log application responds to an external trigger to add a location to the currently-selected log, by obtaining the current location of the mobile entity and logging it to the currently selected log together with a timestamp. The log application continues in state **124** with the same log selected until the user either quits the application or chooses to return to the menu state **120**. The external trigger for adding a location can either be user input (e.g. by operating a hard or soft button) or a command received from another device. Because the log application initiates location-data requests to the location providing means of the mobile entity, it is straightforward to arrange that the log application is only passed relevant location data (that is, location data it has requested) and therefore it will not erroneously log location data provided for other applications.

[0120] If the user chooses the upload option from the menu state, the log application transits first to a selection state **123** in which the user selects the log to be uploaded and then to an upload state **125**. In the upload state the log application oversees the transfer of the selected location log. Upon completion of transfer, the log application returns to the menu state **120**.

[0121] Recording a location independently of taking a photo still has relevance to photo creation. For example, the situation may arise that a user would like to take a photograph of a place or item but has run out of film/on-camera storage, or is present at a time when it is not possible to take a photograph (at night, in heavy rain or mist, etc). In such cases, the user can record their location in their photo location log and subsequently retrieve from the Web (or other photo archive) a photograph similar to that the user wanted to take.

[0122] Where a camera is provided with location discovery means **29** for location stamping photos (see camera **90** in **FIG. 17**), the control means **93** of the camera, when activated by user operation of input control **98**, can be arranged to enable additional location information **98** to be stored in memory **94** without the need to actually record image data **95**; this permits the camera to log the location of desired but untaken photos. The location data that is recorded independently of taking a photo ('independent location data'), is preferably stored in sequence with location data associated with photos actually taken ('recorded-photo location data'). Thus, for example, the independent location data can be treated as a normal 'image+location' data item with zero image data (see item **175**)—in other words, both the location-stamped image data and the independent location data items, are recorded in data structures of the same form, the data structures being arranged in memory or explicitly linked into a sequence indicative of the order of recording. Alternatively, the independent location data can be stored in its own log, separate from the recorded-photo location data, along with sequence data indicating its sequence position relative to the sequence of recorded photo data.

[0123] Whilst separate user controls can be provided for triggering taking of a photo and for triggering the recording of independent location data, in a preferred implementation image recording and independent location recording are both triggered using the same common user-operable control; in this case, a sensor is provided for determining whether there is an image to be recorded (if there is, then a location-stamped image recording is made whereas if no image is present, an independent location data recording is made). This sensor is for example, a sensor for detecting whether a lens shutter of the camera is open or closed; alternatively, the sensor takes the form of an optical sensor located in an image plane of the camera (where the camera includes an electronic image capture device such as element **92** in **FIG. 17**, then this device can be used as the image-presence sensor).

[0124] Matching Separately-Generated Image and Location Data

[0125] In order to accommodate the separate provision of image data and location data, the album program **50** described above with reference to FIGS. **3-8** is adapted as depicted in **FIG. 14**. More particularly, the Load Mode is adapted to independently load the image data and the location data (block **141**), the data loaded from the camera being handled as before but without the location data field being filled in on each photo meta-data record **56** whilst the location data is temporarily stored in a log identified as related to the batch of photos concerned.

[0126] The Catalogue Mode is now split into two operating phases in the first of which the image data and location data are correlated (blocks **142** to **144**), the second phase being the grouping and details-editing stage that formed the original Catalogue Mode. With regard to the first phase, this involves an automatic correlation process (block **142**), followed by a user-directed correlation adjustment process (block **143**); the resultant correlation of image and location

data is then committed for storage by the user (block **144**) at which time the location data field of each photo meta-data record is updated and the separate location log deleted.

[**0127**] In the event that the location log includes desired-but-not-taken photo location data, there is an additional process (see dotted block **146**) between blocks **143** and **144** in which the user is given the option of fetching (or initiating an automatic fetch of) photo image data from the Internet to match the location concerned. This process is depicted in **FIG. 17** where desired image data is supplied (arrow **172**) by a specialised service **174** set up to provide such image data in response to requests (arrow **171**). Preferably, where automatic fetching is implemented, more than one photograph will be retrieved on the basis of location, the user then being presented with a choice of third-party photos to add to the user's own photo album. As a preliminary step to fetching one or more photographs, the user can be presented with a detailed map **147** of the area around the desired-but-not-taken photo location **148**—the user can then specify approximately what subject/view **149** they are interested in (the location data by itself not indicating, for example, the direction in which the user was looking when the location was logged or whether the user was interested in a near field object or a far view). The user can specify the view of interest by, for example, clicking a target point or defining a target area on the map display. The information derived from the user is passed with the request for retrieving relevant photos.

[**0128**] The user may, in fact, decide to defer fetching image data until later in which case the act of committing the existing correlation in block **144** also causes the creation of a photo meta-data record for the desired-but-not-taken photo and such ghost photos will be subsequently represented in the displays of **FIGS. 6 and 7** by "?" icons; clicking on such an icon can be arranged to initiate, at least in the Catalogue Mode, the process for fetching an appropriate image.

[**0129**] Considering now the automatic matching process of block **142**, one efficient way of doing this is by time-stamping digital photos in the camera and time-stamping the location data that is separately created at the same time (approximately) in a different device. Because different clocks are used for the two time stamps, absolute time is not reliable for matching the location data with the photo image data. However, the pattern of timestamps (i.e. time-interval related data) can be used to perform a match. This remains true even when there are additional entries in either the batch of photos or the location log that have no counterpart in the other collection. **FIG. 15** shows an example in which a timestamp sequence **150** of a batch of eight photos is to be matched against a timestamp sequence **151** of a location log with seven entries. The individual photo timestamps are represented by marks **152** whilst the individual location timestamps are represented by marks **151**. As can be seen, it is a relatively easy matter to match up the two patterns of timestamps notwithstanding that there are two time-stamped photos **154** for which there are no corresponding location entries and one time-stamped location **155** for which there is no corresponding photo (this may be because the location corresponds to a desired-but-not-taken photo location). Appropriate pattern matching techniques for effecting the automatic matching of the timestamp sequences **150**, **151** are well known to persons skilled in the art.

[**0130**] The same approach could be used for matching other types of auxiliary data (and not just location data—for example sound clip data) with photos; again, the matching process can be used with any type of recording, not just photos.

[**0131**] As already noted, matching can also be done on the basis of sequence number and this can be done even where the photos are only physical items—in this case, the location data is printed out on numbered self-adhesive labels than can be stuck to the back of the corresponding photos.

[**0132**] Returning to matching location data and photos in the album program **150**, whilst using sequence numbers, for example, seems an easy way to match up a set of photos with a corresponding set of location-data items, it is quite likely that there will be additions/omissions in one set as compared to the other. As a result the match between the sets will be imperfect. Mismatching may also arise where other correlation keys (that is, not sequence position) are used. However, it may generally be assumed that the ordering of entries is the same for both sets.

[**0133**] To correct the match up, a user must intervene and manually correct erroneous associations between entries in the two sets—this being the purpose of the process represented by block **143** in **FIG. 14**. This adjustment process can conveniently be done by generating a Catalogue Mode display such as shown in **FIG. 6** on the basis of the matching achieved after running the automatic match process of block **142** (where implemented), or else simply by pairing off photos with location-data items in sequence order until one of the sets (photos; location-data items) runs out. In the resultant display, lead lines **65** connect photo thumbnails **63** with location markers **64** on the map. To correct an erroneous association, a user drags the map end of the relevant lead line **65** to the correct location marker **64** on the map—or drags the photo end of the lead line to the correct photo (or simply clicks on the matching entries in turn).

[**0134**] To minimize the number of times this needs to be done, use is made of the consistency of the ordering of both sets—in particular, the associations of photos and location data for entries later in the orderings than a just-corrected association, are re-matched taking into account the corrected association. If these entries include an already corrected association, this latter is not disturbed. This feature is illustrated in FIGS. **16**A-D where:

[**0135**] **FIG. 16**A—shows an initial matching of a set of photos **160** with a set of location-data items **161**, the photos and location-data-items being paired off until the location-data item set is exhausted.

[**0136**] **FIG. 16**B—user determines that the third location-data item **165** is actually associated with the fifth photo **166** and corrects the association accordingly; this results in a re-pairing of all location-data items subsequent to the item **165** with photos subsequent to photo **166** as illustrated.

[**0137**] **FIG. 16**C—similarly, user determines that the seventh location-data item **167** is actually associated with the tenth photo **166** and corrects the association accordingly; this results in a re-pairing of all location-data items subsequent to the item **167** with photos subsequent to photo **168** as illustrated.

[0138] **FIG. 16**D—user now decides that the second location-data item **169** should be associated with the third photo **170** and corrects the association accordingly; no consequential downstream adjustments are made since the next association is one previously established by the user (between location data item **165** and photo **166**).

[0139] It will be appreciated that the match-adjustment process described above with reference to **FIG. 16** can be used to associate location data with other types of recordings.

[0140] ANNEX A—Mobile radio infrastructure; Location Determination

[0141] This Annex forms an integral part of the specification.

[0142] Communication infrastructures suitable for mobile users (in particular, though not exclusively, cellular radio infrastructures) have now become widely adopted. Whilst the primary driver has been mobile telephony, the desire to implement mobile data-based services over these infrastructures, has led to the rapid development of data-capable bearer services across such infrastructures. This has opened up the possibility of many Internet-based services being available to mobile users.

[0143] By way of example, **FIG. 2** shows one form of known communication infrastructure for mobile users providing both telephony and data-bearer services. In this example, a mobile entity **20**, provided with a radio subsystem **22** and a phone subsystem **23**, communicates with the fixed infrastructure of GSM PLMN (Public Land Mobile Network) **10** to provide basic voice telephony services. In addition, the mobile entity **20** includes a data-handling subsystem **25** inter-working, via data interface **24**, with the radio subsystem **22** for the transmission and reception of data over a data-capable bearer service provided by the PLMN; the data-capable bearer service enables the mobile entity **20** to communicate with a service system **40** connected to the public Internet **39**. The data handling subsystem **25** supports an operating environment **26** in which applications run, the operating environment including an appropriate communications stack.

[0144] More particularly, the fixed infrastructure **10** of the GSM PLMN comprises one or more Base Station Subsystems (BSS) **11** and a Network and Switching Subsystem NSS **12**. Each BSS **11** comprises a Base Station Controller (BSC) **14** controlling multiple Base Transceiver Stations (BTS) **13** each associated with a respective "cell" of the radio network. When active, the radio subsystem **22** of the mobile entity **20** communicates via a radio link with the BTS **13** of the cell in which the mobile entity is currently located. As regards the NSS **12**, this comprises one or more Mobile Switching Centers (MSC) **15** together with other elements such as Visitor Location Registers **32** and Home Location Register **32**.

[0145] When the mobile entity **20** is used to make a normal telephone call, a traffic circuit for carrying digitised voice is set up through the relevant BSS **11** to the NSS **12** which is then responsible for routing the call to the target phone (whether in the same PLMN or in another network).

[0146] With respect to data transmission to/from the mobile entity **20**, in the present example three different data-capable bearer services are depicted though other possibilities exist. A first data-capable bearer service is available in the form of a Circuit Switched Data (CSD) service; in this case a full traffic circuit is used for carrying data and the MSC **32** routes the circuit to an Inter-Working Function IWF **34** the precise nature of which depends on what is connected to the other side of the IWF. Thus, IWF could be configured to provide direct access to the public Internet **39** (that is, provide functionality similar to an IAP—Internet Access Provider IAP). Alternatively, the IWF could simply be a modem connecting to a PSTN; in this case, Internet access can be achieved by connection across the PSTN to a standard IAP.

[0147] A second, low bandwidth, data-capable bearer service is available through use of the Short Message Service that passes data carried in signalling channel slots to an SMS unit which can be arranged to provide connectivity to the public Internet **39**.

[0148] A third data-capable bearer service is provided in the form of GPRS (General Packet Radio Service which enables IP (or X.25) packet data to be passed from the data handling system of the mobile entity **20**, via the data interface **24**, radio subsystem **21** and relevant BSS **11**, to a GPRS network **17** of the PLMN **10** (and vice versa). The GPRS network **17** includes a SGSN (Serving GPRS Support Node) **18** interfacing BSC **14** with the network **17**, and a GGSN (Gateway GPRS Support Node) interfacing the network **17** with an external network (in this example, the public Internet **39**). Full details of GPRS can be found in the ETSI (European Telecommunications Standards Institute) GSM 03.60 specification. Using GPRS, the mobile entity **20** can exchange packet data via the BSS **11** and GPRS network **17** with entities connected to the public Internet **39**.

[0149] The data connection between the PLMN **10** and the Internet **39** will generally be through a firewall **35** with proxy and/or gateway functionality.

[0150] Different data-capable bearer services to those described above may be provided, the described services being simply examples of what is possible.

[0151] In **FIG. 2, a** service system **40** is shown connected to the Internet **40**, this service system being accessible to the OS/application **26** running in the mobile entity by use of any of the data-capable bearer services described above. The data-capable bearer services could equally provide access to a service system that is within the domain of the PLMN operator or is connected to another public or private data network.

[0152] With regard to the OS/application software **26** running in the data handling subsystem **25** of the mobile entity **20**, this could, for example, be a WAP application running on top of a WAP stack where "WAP" is the Wireless Application Protocol standard. Details of WAP can be found, for example, in the book "Official Wireless Application Protocol" Wireless Application Protocol Forum, Ltd published 1999 Wiley Computer Publishing. Where the OS/application software is WAP compliant, the firewall will generally also serve as a WAP proxy and gateway. Of course, OS/application **26** can comprise other functionality (for example, an e-mail client) instead of, or additional to, the WAP functionality.

[0153] The mobile entity **20** may take many different forms. For example, it could be two separate units such as

a mobile phone (providing elements **22-24**) and a mobile PC (data-handling system **25**) coupled by an appropriate link (wire-line, infrared or even short range radio system such as Bluetooth). Alternatively, mobile entity **20** could be a single unit such as a mobile phone with WAP functionality. Of course, if only data transmission/reception is required (and not voice), the phone functionality **24** can be omitted; an example of this is a PDA with built-in GSM data-capable functionality whilst another example is a digital camera (the data-handling subsystem) also with built-in GSM data-capable functionality enabling the upload of digital images from the camera to a storage server.

[0154] As regards the service provided by the service system **40**, this can be a location-aware service (also known as a "location-based" or "location-dependent" service), being a service that takes account of the current location of the mobile entity **20**. The most basic form of this service is the emergency location service whereby a user in trouble can press a panic button on their mobile phone to send an emergency request-for-assistance message with their location data appended. Another well known location-based service is the provision of traffic and route-guiding information to vehicle drivers based on their current position. A further known service is a "yellow pages" service where a user can find out about amenities (shops, restaurants, theatres, etc.) local to their current location.

[0155] Location-aware services all require user location as an input parameter. A number of methods already exist for determining the location of a mobile user as represented by an associated mobile equipment. In addition to location discovery systems based on GPS (Global Positioning System), there exist a number of other systems the most notable of which are those that rely on cellular radio infrastructures. More particularly, within a PLMN coverage area, it is possible to get a reasonably accurate fix on the location of a mobile entity by measuring timing and/or directional parameters between the mobile entity and multiple BTSs **13**, these measurement being done either in the network or the mobile entity (see, for example, International Application WO 99/04582 that describes various techniques for effecting location determination in the mobile and WO 99/55114 that describes location determination by the mobile network in response to requests made by location-aware applications to a mobile location center-server-of the mobile network).

[0156] **FIG. 2** depicts the case of location determination being done in the network, for example, by making Timing Advance measurements for three BTSs **13** and using these measurements to derive location (this derivation typically being done in a unit associated with BSC **14**). The resultant location data is passed to a location server **41** from where it can be made available to authorised services. Thus, when the mobile entity **20** wishes to invoke a location-aware service available on service system **40**, it sends a request to service system **40** via a data-capable bearer service of the PLMN **10** and the internet **39**; this request includes an authorisation token and the mobile entity ID (possible embedded in the token). The service system then uses the authorisation token to obtain the current location of the mobile entity **20**G from the location server **41** (the location server **41** will probably not be holding current location data for the mobile entity **20** and will need to request the appropriate BSC to determine this data before returning it to the service system **40**). The use of an authorisation token is unnecessary if the service has been prior authorised to the location service by the mobile entity. Of course, as an alternative to having the service obtain location data from the location server **41**, the mobile entity could have requested its location from the location server and then included this information in the request to the location-aware service running on service system **40**.

[0157] Whilst the above description has been given with reference to a PLMN based on GSM technology, it will be appreciated that many other cellular radio technologies exist and can typically provide the same type of functionality as described for the GSM PLMN **10**.

1. A digital camera comprising:

an image recording subsystem for making image recordings;

a location-providing subsystem for providing location data items representative of a current location of the camera,

a location-stamping subsystem for associating with image recordings taken using the image recording subsystem, respective location data items, provided by said location-providing subsystem, that each represent the location of the camera at the time the corresponding image recording was taken, and

a location recording subsystem for effecting user-triggered recording, independently of the recording of an image recording, of location data items provided by the location providing subsystem, these location data items and those associated with the location-stamped image recordings being recorded in a sequential association with each other.

2. A camera according to claim 1, wherein both the location-stamped image recordings and the location data items recorded independently of recording an image recording, are recorded in data structures of the same form, the data structures being arranged or explicitly linked into a sequence indicative of the order of recording.

3. A camera according to claim 1, wherein each location data item recorded independently of recording an image recording, is recorded in a log distinct from the location-stamped image recordings along with sequence data indicating its sequence position relative to the sequence of recorded image recordings.

4. A camera according to claim 1, wherein the image recording subsystem and the location recording subsystem have independent user-operable controls for triggering recording.

5. A camera according to claim 1, wherein the image recording subsystem and the location recording subsystem have a common user-operable control for triggering recording and a common sensor for determining whether there is an image to be recorded, the image recording subsystem being operative to record an image recording when said control is operated only if said sensor indicates that an image is present, and the location recording subsystem only recording a location data item when said control is operated, if said sensor indicates that an image is absent.

6. A camera according to claim 5, wherein said sensor is a sensor for detecting whether a lens shutter of the camera is open or closed.

7. A camera according to claim 5, wherein sensor is an optical sensor located in an image plane of the camera.

8. A camera according to claim 7, wherein said optical sensor is constituted by an electronic image capture device of the image recording subsystem.

9. A camera according to claim 1, wherein the location providing subsystem is a GPS subsystem.

10. A camera according to claim 1, wherein the location providing subsystem comprises a cellular mobile radio subsystem for receiving location-related data from a mobile radio infrastructure.

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