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Application No.:	**Divisional of US 13/037317**
Filed:	
Applicant:	**Evryx Technologies, Inc.**
Title:	**Image Capture and Identification System and Process**
Docket No.:	**101044.0001US14**
Customer No.:	**24392**

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

PRELIMINARY AMENDMENT

Sir:

Concurrent with filing of a divisional application for pending US Application Serial No. 13/037317, please amend the above-identified application as follows:

Amendments to the Claims are reflected in the amendments beginning on page 2 of this paper

Amendments to the Specification are reflected in the listing of claims which begins on page 4 of this paper.

Amendments to the Drawings -/-

Remarks/Arguments begin on page 6 of this paper.

Appendix: -/-

AMENDMENTS TO THE CLAIMS

This listing of claims replaces all prior versions, and listings, of claims in the application:

1-44. (Cancelled)

45. (New) A transaction system comprising:

a mobile device configured to acquire data related to an object;

an object identification platform configured to obtain the acquired data, recognize the object as a target object based on the acquired data, and determine object information associated with the target object; and

a content platform configured to obtain the object information, and initiate a transaction associated with the target object with a selected account over a network based on the object information.

45. (New) The system of claim 1, wherein the mobile device is configured to operate, at least in part, as the object identification platform.

46. (New) The system of claim 2, wherein the object identification platform is distributed between the mobile device and at least one remote server coupled with the mobile device via a network.

47. (New) The system of claim 1, wherein a remote server coupled with the mobile device over a network is configured to operate as the object identification platform.

48. (New) The system of claim 1, wherein the mobile device comprises the content platform.

49. (New) The system of claim 1, wherein at least one remote server coupled with the mobile device over a network operates as the content platform.

50. (New) The system of claim 1, wherein the content platform is further configured to provide content information pertinent to the target object to the mobile device based on the object information.

51. (New) The system of claim 7, wherein the content information comprises video.

52. (New) The system of claim 8, wherein the content information comprises a video stream.

53. (New) The system of claim 7, wherein the content information comprises audio.

54. (New) The system of claim 8, wherein the audio comprises an audio recording.

55. (New) The system of claim 8, wherein the audio comprises an audio stream.

56. (New) The system of claim 1, wherein the transaction comprises a commercial transaction.

57. (New) The system of claim 13, wherein the commercial transaction includes a purchase related to the target object.

58. (New) The system of claim 14, wherein the purchase relates to at least one of the following: audio data, video data, the object, the target object, a ticket, an item on a screen, a disc, a fare, and a vending machine product.

59. (New) The system of claim 1, wherein the selected account comprises an on-line account.

60. (New) The system of claim 1, wherein the selected account comprises an account linked with the mobile device.

61. (New) The system of claim 1, wherein the selected account comprises an account linked to a user of the mobile device.

62. (New) The system of claim 1, wherein the selected account comprises a bank account.

63. (New) The system of claim 1, wherein the selected account comprises a credit card account.

64. (New) The system of claim 1, wherein the acquired data comprises an image.

65. (New) The system of claim 21, wherein the acquired data comprises image data.

66. (New) The system of claim 1, wherein the acquired data comprises a digital representation relating to a person.

67. (New) The system of claim 23, wherein the digital representation comprises a human face.

68. (New) The system of claim 1, wherein the acquired data comprises user identify.

69. (New) The system of claim 1, wherein the acquired data comprises location of the mobile device.

70. (New) The system of claim 1, wherein the acquired data comprises screen content.

71. (New) The system of claim 1, wherein the acquired data comprises a user voice command.

72. (New) The system of claim 1, wherein the acquired data comprises symbol content.

73. (New) The system of claim 29, wherein the symbol content comprises alphanumeric data.

74. (New) The system of claim 1, wherein the object information comprises an object identity.

75. (New) The system of claim 31, wherein the object identify comprises an object classification.

76. (New) The system of claim 1, wherein the object information comprises an object status.

77. (New) The system of claim 1, wherein the object information comprises decoded symbol information.

78. (New) The system of claim 1, wherein the object information comprises an object attribute.

79. (New) The system of claim 1, wherein the mobile device comprises a mobile telephone.

80. (New) The system of claim 36, wherein the mobile device comprises a camera equipped mobile telephone.

81. (New) The system of claim 1, wherein the mobile device comprises a vehicle.

AMENDEMENTS TO THE SPECIFICATION

Priority Claim

Please insert the following priority claim on line 2 of page 1 of the application as follows:

<u>This application is a divisional of 13/037317 filed February 28, 2011 which is a divisional of 12/333630 filed December 12, 2008 which is a divisional of 10/492243 filed April 9, 2004 which is a National Phase of PCT/US02/35407 filed November 5, 2002 which is an International Patent application of 09/992942 filed November 5, 2001 which claims priority to provisional application number 60/317521 filed Sept. 5, 2001 and provisional application number 60/246295 filed Nov. 6, 2000. These and all other referenced patents and applications are incorporated herein by reference in their entirety. Where a definition or use of a term in a reference that is incorporated by reference is inconsistent or contrary to the definition of that term provided herein, the definition of that term provided herein is deemed to be controlling.</u>

Attorney Docket Number

The attorney docket number for this matter is 101044.0001US14.

REMARKS/ARGUMENTS

General Remarks

Claims 1-44 of the copending parent application were canceled and new claims 45-81 were added. The **specification** was amended to make **reference to the priority application**, and to further **comply with rules** and regulations for applications with only a single figure. No new matter was entered by virtue of the amendments.

The applicant believes that all claims are in condition for allowance and respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

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(12) Patent Application Publication
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Boncyk et al.

(54) **IMAGE CAPTURE AND IDENTIFICATION SYSTEM AND PROCESS**

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Related U.S. Application Data

(62) Division of application No. 10/493,343, filed on Apr. 22, 2004, now Pat. No. 7,162,886.

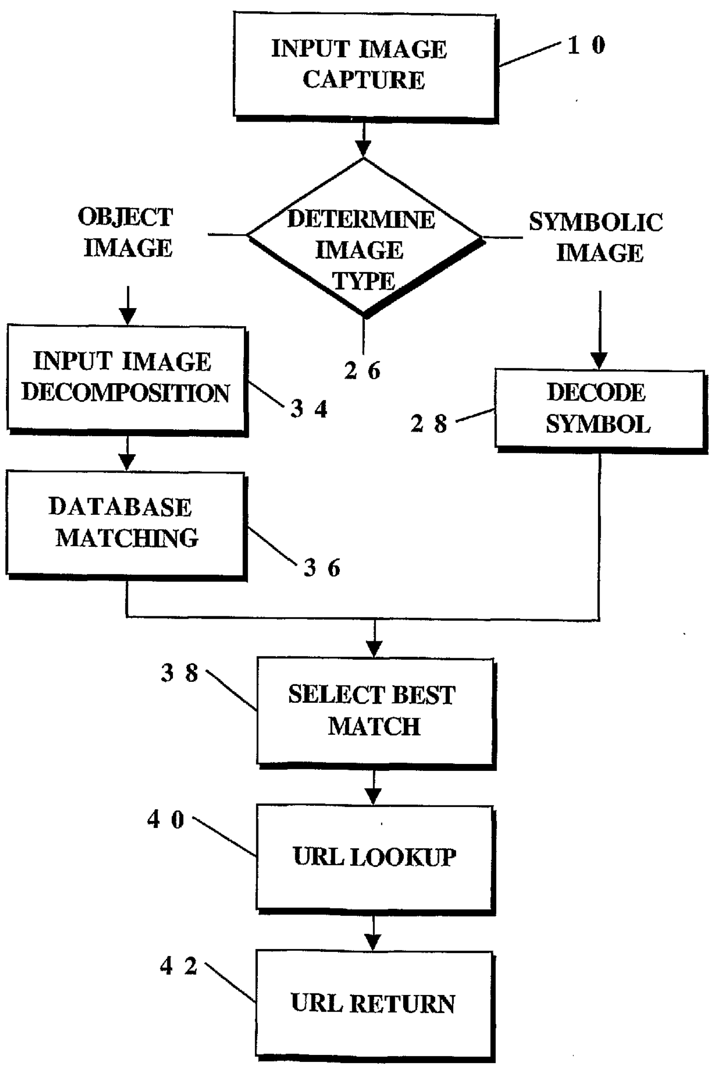
Publication Classification

(51) **Int. Cl.**
G06K 9/62 (2006.01)

(52) **U.S. Cl.** **382/209**

(57) **ABSTRACT**

A digital image of the object (**16**) is captured and the object is recognized from plurality of objects in a database (**20**). An information address corresponding to the object is then used to access information and initiate communication pertinent to the object.



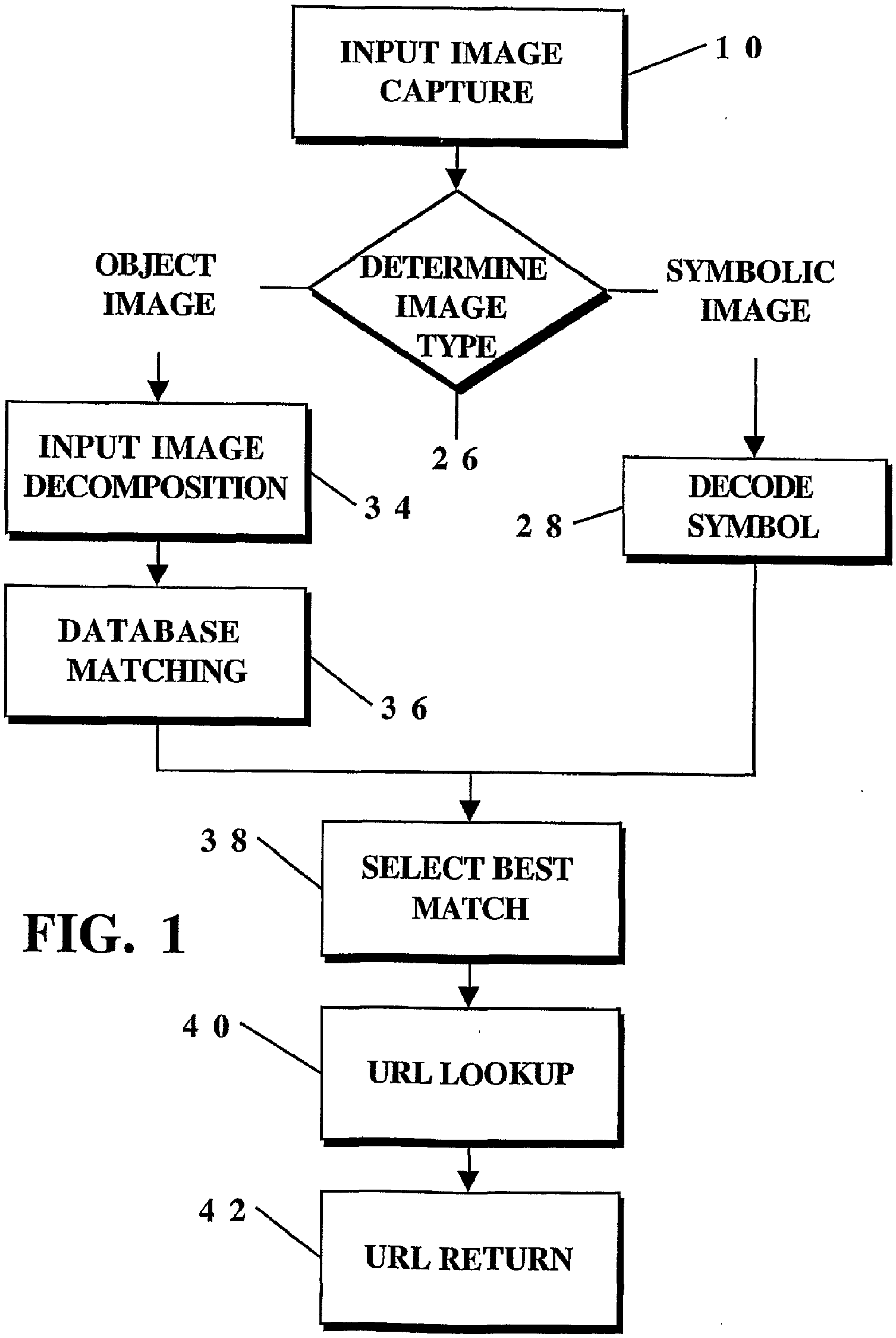

INPUT IMAGE CAPTURE
10
DETERMINE IMAGE TYPE
OBJECT IMAGE
SYMBOLIC IMAGE
26
INPUT IMAGE DECOMPOSITION
34
DECODE SYMBOL
28
DATABASE MATCHING
36
38
SELECT BEST MATCH
40
URL LOOKUP
42
URL RETURN

FIG. 1

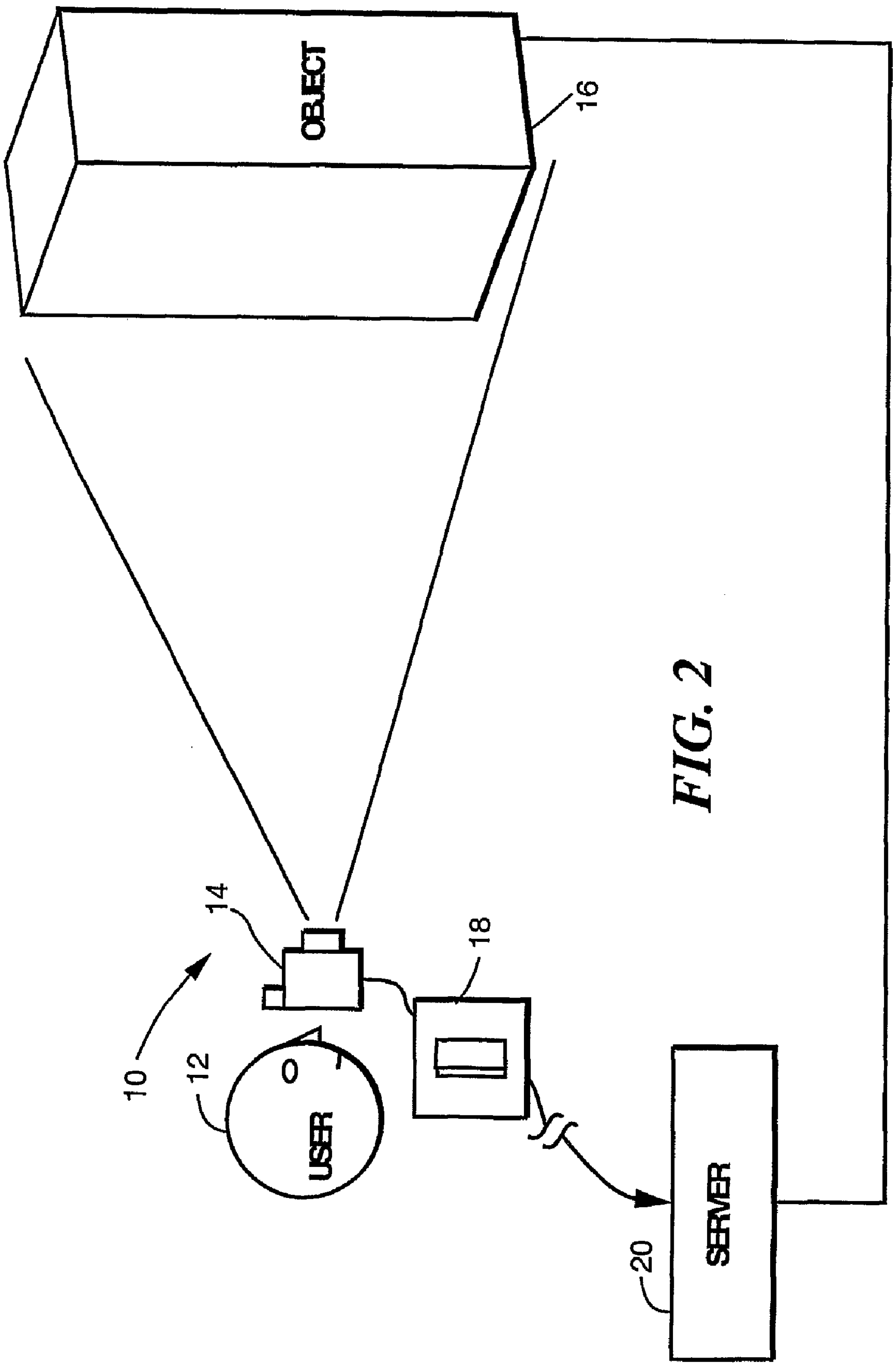


FIG. 2

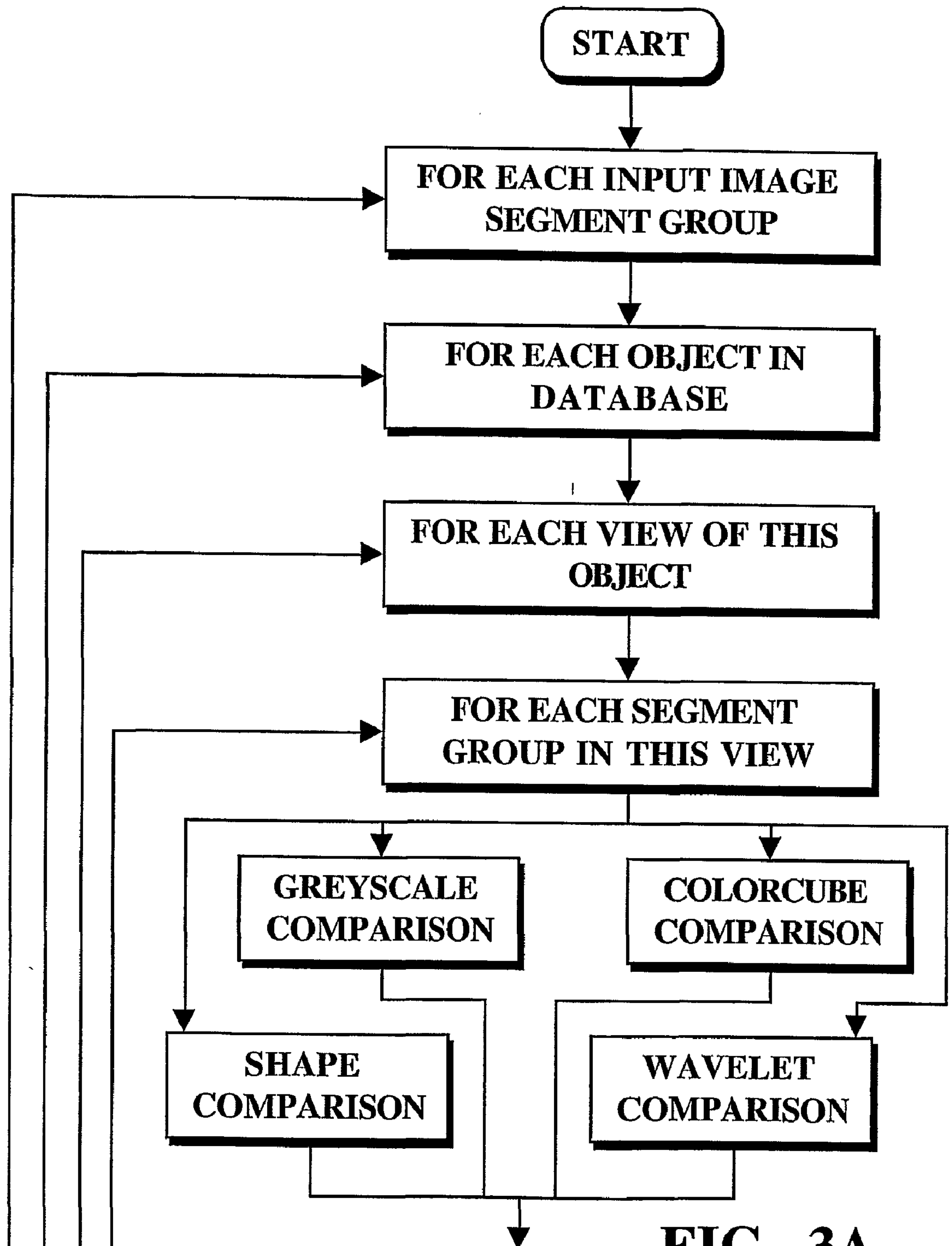

START
FOR EACH INPUT IMAGE SEGMENT GROUP
FOR EACH OBJECT IN DATABASE
FOR EACH VIEW OF THIS OBJECT
FOR EACH SEGMENT GROUP IN THIS VIEW
GREYSCALE COMPARISON
COLORCUBE COMPARISON
SHAPE COMPARISON
WAVELET COMPARISON

FIG. 3A

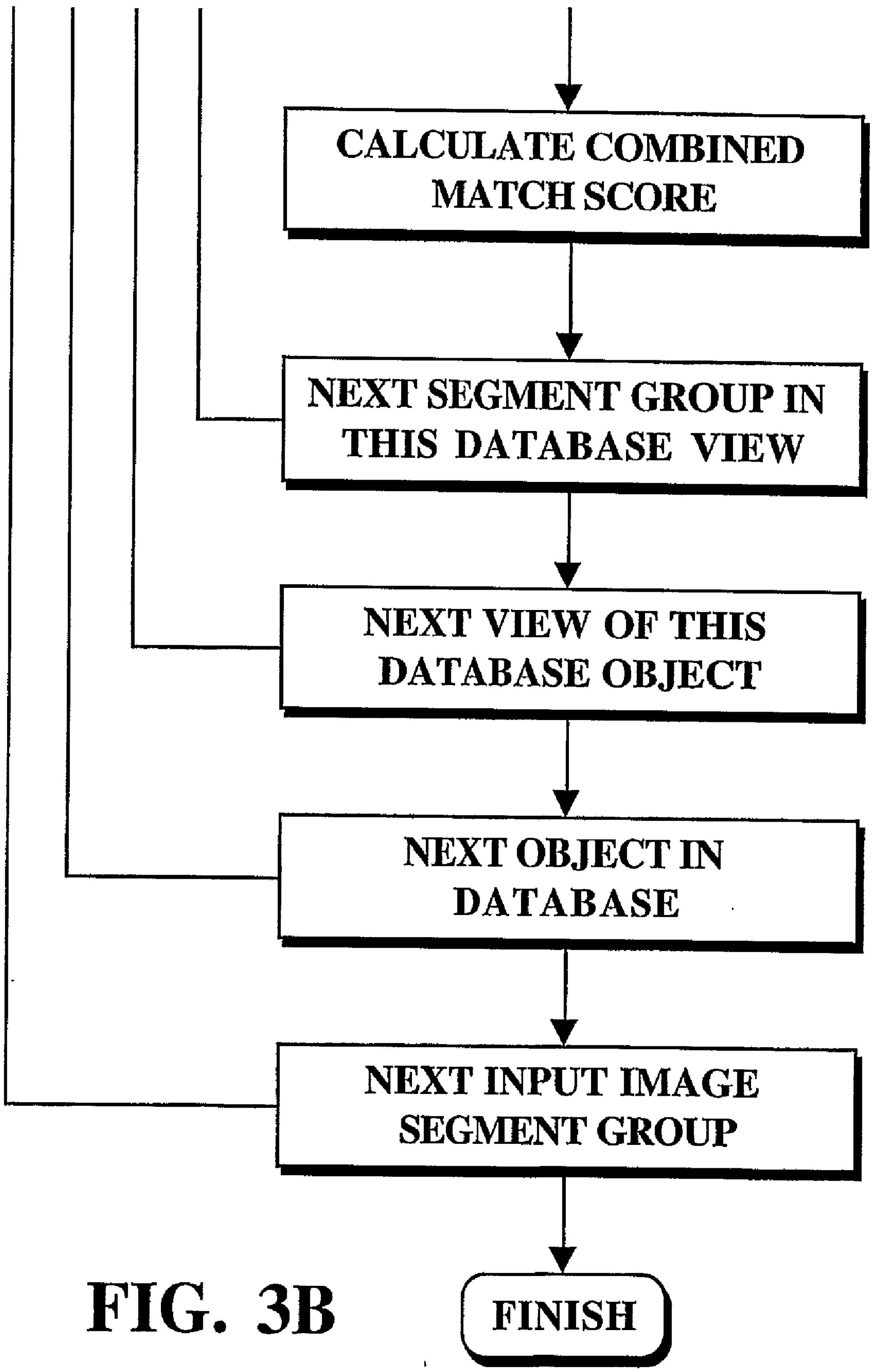

CALCULATE COMBINED MATCH SCORE
NEXT SEGMENT GROUP IN THIS DATABASE VIEW
NEXT VIEW OF THIS DATABASE OBJECT
NEXT OBJECT IN DATABASE
NEXT INPUT IMAGE SEGMENT GROUP
FINISH

FIG. 3B

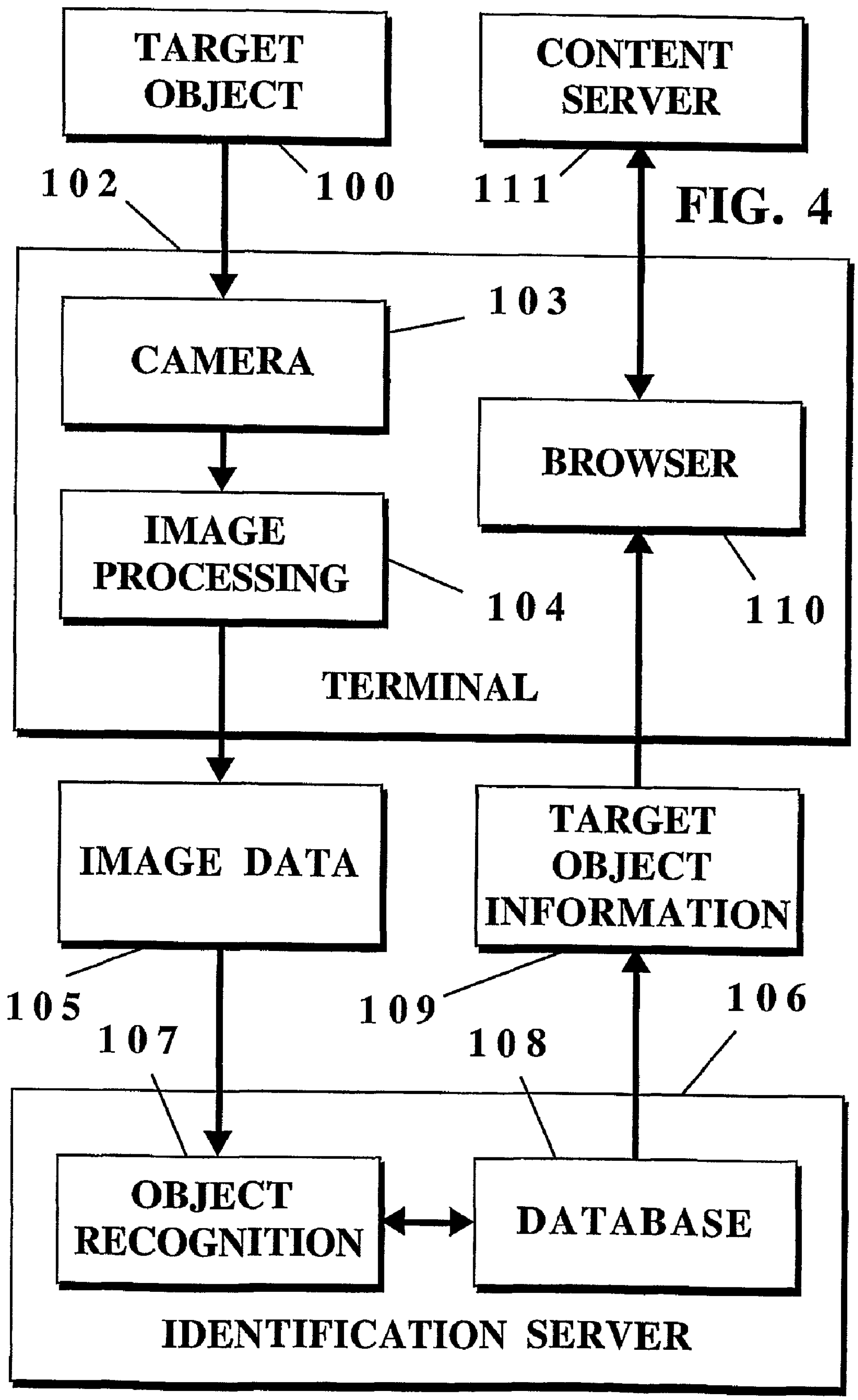

TARGET OBJECT
CONTENT SERVER
102
100
111
CAMERA
103
BROWSER
IMAGE PROCESSING
104
110
TERMINAL
IMAGE DATA
TARGET OBJECT INFORMATION
105
107
109
108
106
OBJECT RECOGNITION
DATABASE
IDENTIFICATION SERVER

FIG. 4

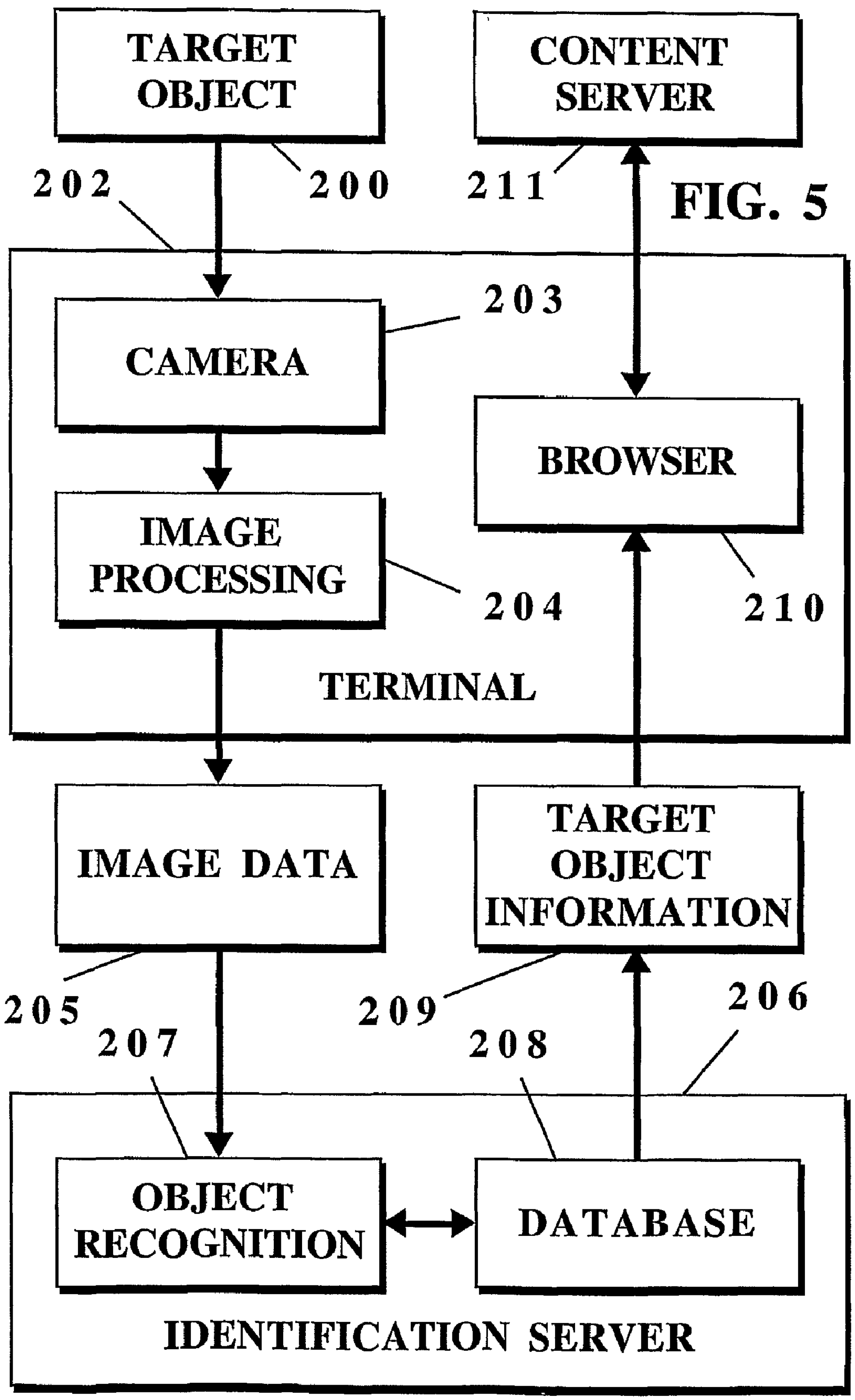

TARGET OBJECT
CONTENT SERVER
202
200
211
CAMERA
203
BROWSER
IMAGE PROCESSING
204
210
TERMINAL
IMAGE DATA
TARGET OBJECT INFORMATION
205
209
206
207
208
OBJECT RECOGNITION
DATABASE
IDENTIFICATION SERVER

FIG. 5

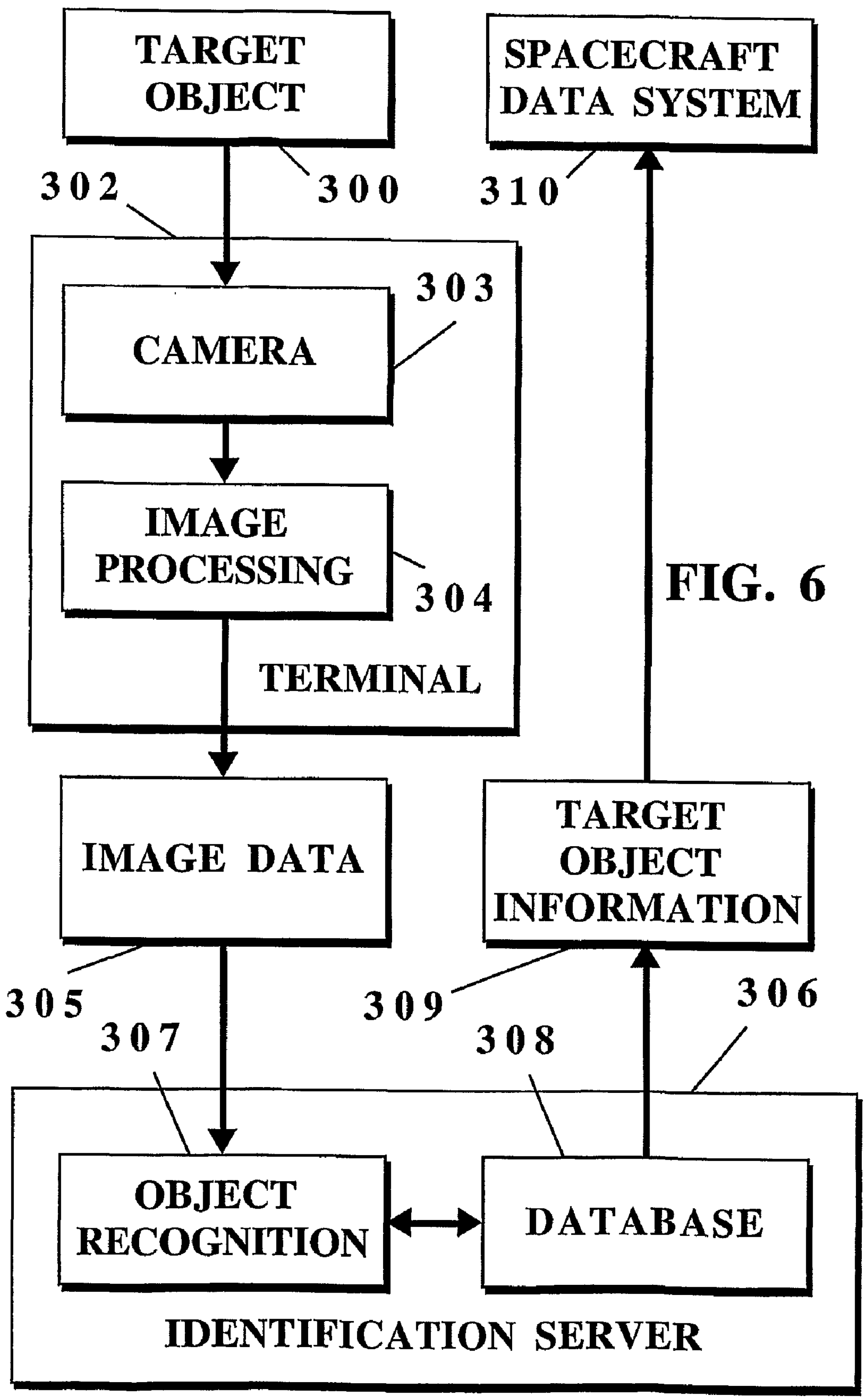

TARGET OBJECT
SPACECRAFT DATA SYSTEM
302
300
310
303
CAMERA
IMAGE PROCESSING
304
TERMINAL
IMAGE DATA
TARGET OBJECT INFORMATION
305
309
306
307
308
OBJECT RECOGNITION
DATABASE
IDENTIFICATION SERVER

FIG. 6

IMAGE CAPTURE AND IDENTIFICATION SYSTEM AND PROCESS

TECHNICAL FIELD

[0001] The invention relates an identification method and process for objects from digitally captured images thereof that uses image characteristics to identify an object from a plurality of objects in a database.

BACKGROUND ART

[0002] There is a need to provide hyperlink functionality in known objects without modification to the objects, through reliably detecting and identifying the objects based only on the appearance of the object, and then locating and supplying information pertinent to the object or initiating communications pertinent to the object by supplying an information address, such as a Uniform Resource Locator (URL), pertinent to the object.

[0003] There is a need to determine the position and orientation of known objects based only on imagery of the objects.

[0004] The detection, identification, determination of position and orientation, and subsequent information provision and communication must occur without modification or disfigurement of the object, without the need for any marks, symbols, codes, barcodes, or characters on the object, without the need to touch or disturb the object, without the need for special lighting other than that required for normal human vision, without the need for any communication device (radio frequency, infrared, etc.) to be attached to or nearby the object, and without human assistance in the identification process. The objects to be detected and identified may be 3-dimensional objects, 2-dimensional images (e.g., on paper), or 2-dimensional images of 3-dimensional objects, or human beings.

[0005] There is a need to provide such identification and hyperlink services to persons using mobile computing devices, such as Personal Digital Assistants (PDAs) and cellular telephones.

[0006] There is a need to provide such identification and hyperlink services to machines, such as factory robots and spacecraft.

Examples include:

[0007] Identifying pictures or other art in a museum, where it is desired to provide additional information about such art objects to museum visitors via mobile wireless devices;

[0008] provision of content (information, text, graphics, music, video, etc.), communications, and transaction mechanisms between companies and individuals, via networks (wireless or otherwise) initiated by the individuals "pointing and clicking" with camera-equipped mobile devices on magazine advertisements, posters, billboards, consumer products, music or video disks or tapes, buildings, vehicles, etc.;

[0009] establishment of a communications link with a machine, such a vending machine or information kiosk, by "pointing and clicking" on the machine with a camera-equipped mobile wireless device and then execution of communications or transactions between the mobile wireless device and the machine;

[0010] identification of objects or parts in a factory, such as on an assembly line, by capturing an image of the objects or parts, and then providing information pertinent to the identified objects or parts;

[0011] identification of a part of a machine, such as an aircraft part, by a technician "pointing and clicking" on the part with a camera-equipped mobile wireless device, and then supplying pertinent content to the technician, such maintenance instructions or history for the identified part;

[0012] identification or screening of individual(s) by a security officer "pointing and clicking" a camera-equipped mobile wireless device at the individual(s) and then receiving identification information pertinent to the individuals after the individuals have been identified by face recognition software;

[0013] identification, screening, or validation of documents, such as passports, by a security officer "pointing and clicking" a camera-equipped device at the document and receiving a response from a remote computer;

[0014] determination of the position and orientation of an object in space by a spacecraft nearby the object, based on imagery of the object, so that the spacecraft can maneuver relative to the object or execute a rendezvous with the object;

[0015] identification of objects from aircraft or spacecraft by capturing imagery of the objects and then identifying the objects via image recognition performed on a local or remote computer;

[0016] watching movie previews streamed to a camera-equipped wireless device by "pointing and clicking" with such a device on a movie theatre sign or poster, or on a digital video disc box or videotape box;

[0017] listening to audio recording samples streamed to a camera-equipped wireless device by "pointing and clicking" with such a device on a compact disk (CD) box, videotape box, or print media advertisement;

[0018] purchasing movie, concert, or sporting event tickets by "pointing and clicking" on a theater, advertisement, or other object with a camera-equipped wireless device;

[0019] purchasing an item by "pointing and clicking" on the object with a camera-equipped wireless device and thus initiating a transaction;

[0020] interacting with television programming by "pointing and clicking" at the television screen with a camera-equipped device, thus capturing an image of the screen content and having that image sent to a remote computer and identified, thus initiating interaction based on the screen content received (an example is purchasing an item on the television screen by "pointing and clicking" at the screen when the item is on the screen);

[0021] interacting with a computer-system based game and with other players of the game by "pointing and clicking" on objects in the physical environment that are considered to be part of the game;

[0022] paying a bus fare by "pointing and clicking" with a mobile wireless camera-equipped device, on a fare machine in a bus, and thus establishing a communications link between the device and the fare machine and enabling the fare payment transaction;

[0023] establishment of a communication between a mobile wireless camera-equipped device and a computer with an Internet connection by "pointing and clicking" with the device on the computer and thus providing to the mobile device an Internet address at which it can communicate with the computer, thus establishing communications with the computer despite the absence of a local network or any direct communication between the device and the computer;

[0024] use of a mobile wireless camera-equipped device as a point-of-sale terminal by, for example, "pointing and clicking" on an item to be purchased, thus identifying the item and initiating a transaction;

DISCLOSURE OF INVENTION

[0025] The present invention solves the above stated needs. Once an image is captured digitally, a search of the image determines whether symbolic content is included in the image. If so the symbol is decoded and communication is opened with the proper database, usually using the Internet, wherein the best match for the symbol is returned. In some instances, a symbol may be detected, but non-ambiguous identification is not possible. In that case and when a symbolic image can not be detected, the image is decomposed through identification algorithms where unique characteristics of the image are determined. These characteristics are then used to provide the best match or matches in the data base, the "best" determination being assisted by the partial symbolic information, if that is available.

[0026] Therefore the present invention provides technology and processes that can accommodate linking objects and images to information via a network such as the Internet, which requires no modification to the linked object. Traditional methods for linking objects to digital information, including applying a barcode, radio or optical transceiver or transmitter, or some other means of identification to the object, or modifying the image or object so as to encode detectable information in it, are not required because the image or object can be identified solely by its visual appearance. The users or devices may even interact with objects by "linking" to them. For example, a user may link to a vending machine by "pointing and clicking" on it. His device would be connected over the Internet to the company that owns the vending machine. The company would in turn establish a connection to the vending machine, and thus the user would have a communication channel established with the vending machine and could interact with it.

[0027] The decomposition algorithms of the present invention allow fast and reliable detection and recognition of images and/or objects based on their visual appearance in an image, no matter whether shadows, reflections, partial obscuration, and variations in viewing geometry are present. As stated above, the present invention also can detect, decode, and identify images and objects based on traditional symbols which may appear on the object, such as alphanumeric characters, barcodes, or 2-dimensional matrix codes.

[0028] When a particular object is identified, the position and orientation of an object with respect to the user at the time the image was captured can be determined based on the appearance of the object in an image. This can be the location and/or identity of people scanned by multiple cameras in a security system, a passive locator system more accurate than GPS or usable in areas where GPS signals cannot be received, the location of specific vehicles without requiring a transmission from the vehicle, and many other uses.

[0029] When the present invention is incorporated into a mobile device, such as a portable telephone, the user of the device can link to images and objects in his or her environment by pointing the device at the object of interest, then "pointing and clicking" to capture an image. Thereafter, the device transmits the image to another computer ("Server"), wherein the image is analyzed and the object or image of interest is detected and recognized. Then the network address of information corresponding to that object is transmitted from the ("Server") back to the mobile device, allowing the mobile device to access information using the network address so that only a portion of the information concerning the object need be stored in the systems database.

[0030] Some or all of the image processing, including image/object detection and/or decoding of symbols detected in the image may be distributed arbitrarily between the mobile (Client) device and the Server. In other words, some processing may be performed in the Client device and some in the Server, without specification of which particular processing is performed in each, or all processing may be performed on one platform or the other, or the platforms may be combined so that there is only one platform. The image processing can be implemented in a parallel computing manner, thus facilitating scaling of the system with respect to database size and input traffic loading.

[0031] Therefore, it is an object of the present invention to provide a system and process for identifying digitally captured images without requiring modification to the object.

[0032] Another object is to use digital capture devices in ways never contemplated by their manufacturer.

[0033] Another object is to allow identification of objects from partial views of the object.

[0034] Another object is to provide communication means with operative devices without requiring a public connection therewith.

[0035] These and other objects and advantages of the present invention will become apparent to those skilled in the art after considering the following detailed specification, together with the accompanying drawings wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

[0036] FIG. **1** is a schematic block diagram top-level algorithm flowchart;

[0037] FIG. **2** is an idealized view of image capture;

[0038] FIGS. **3**A and **3**B are a schematic block diagram of process details of the present invention;

[0039] FIG. **4** is a schematic block diagram of a different explanation of invention;

[0040] FIG. **5** is a schematic block diagram similar to FIG. **4** for cellular telephone and personal data assistant (PDA0 applications; and

[0041] FIG. **6** is a schematic block diagram for spacecraft applications.

BEST MODES FOR CARRYING OUT THE INVENTION

[0042] The present invention includes a novel process whereby information such as Internet content is presented to a user, based solely on a remotely acquired image of a physical object. Although coded information can be included in the remotely acquired image, it is not required since no additional information about a physical object, other than its image, needs to be encoded in the linked object. There is no need for any additional code or device, radio, optical or otherwise, to be embedded in or affixed to the object. Image-linked objects can be located and identified within user-acquired imagery solely by means of digital image processing, with the address of pertinent information being returned to the device used to acquire the image and perform the link. This process is robust against digital image noise and corruption (as can result from lossy image compression/decompression), perspective error, rotation, translation, scale differences, illumination variations caused by different lighting sources, and partial obscuration of the target that results from shadowing, reflection or blockage.

[0043] Many different variations on machine vision "target location and identification" exist in the current art. However, they all tend to provide optimal solutions for an arbitrarily restricted search space. At the heart of the present invention is a high-speed image matching engine that returns unambiguous matches to target objects contained in a wide variety of potential input images. This unique approach to image matching takes advantage of the fact that at least some portion of the target object will be found in the user-acquired image. The parallel image comparison processes embodied in the present search technique are, when taken together, unique to the process. Further, additional refinement of the process, with the inclusion of more and/or different decomposition-parameterization functions, utilized within the overall structure of the search loops is not restricted. The detailed process is described in the following. FIG. **1** shows the overall processing flow and steps. These steps are described in further detail in the following sections.

[0044] For image capture **10**, the User **12** (FIG. **2**) utilizes a computer, mobile telephone, personal digital assistant, or other similar device **14** equipped with an image sensor (such as a CCD or CMOS digital camera). The User **12** aligns the sensor of the image capture device **14** with the object **16** of interest. The linking process is then initiated by suitable means including: the User **12** pressing a button on the device **14** or sensor; by the software in the device **14** automatically recognizing that an image is to be acquired; by User voice command; or by any other appropriate means. The device **14** captures a digital image **18** of the scene at which it is pointed. This image **18** is represented as three separate 2-D matrices of pixels, corresponding to the raw RGB (Red, Green, Blue) representation of the input image. For the purposes of standardizing the analytical processes in this embodiment, if the device **14** supplies an image in other than RGB format, a transformation to RGB is accomplished. These analyses could be carried out in any standard color format, should the need arise.

[0045] If the server **20** is physically separate from the device **14**, then user acquired images are transmitted from the device **14** to the Image Processor/Server **20** using a conventional digital network or wireless network means. If the image **18** has been compressed (e.g. via lossy JPEG DCT) in a manner that introduces compression artifacts into the reconstructed image **18**, these artifacts may be partially removed by, for example, applying a conventional despeckle filter to the reconstructed image prior to additional processing.

[0046] The Image Type Determination **26** is accomplished with a discriminator algorithm which operates on the input image **18** and determines whether the input image contains recognizable symbols, such as barcodes, matrix codes, or alphanumeric characters. If such symbols are found, the image **18** is sent to the Decode Symbol **28** process. Depending on the confidence level with which the discriminator algorithm finds the symbols, the image **18** also may or alternatively contain an object of interest and may therefore also or alternatively be sent to the Object Image branch of the process flow. For example, if an input image **18** contains both a barcode and an object, depending on the clarity with which the barcode is detected, the image may be analyzed by both the Object Image and Symbolic Image branches, and that branch which has the highest success in identification will be used to identify and link from the object.

[0047] The image is analyzed to determine the location, size, and nature of the symbols in the Decode Symbol **28**. The symbols are analyzed according to their type, and their content information is extracted. For example, barcodes and alphanumeric characters will result in numerical and/or text information.

[0048] For object images, the present invention performs a "decomposition", in the Input Image Decomposition **34**, of a high-resolution input image into several different types of quantifiable salient parameters. This allows for multiple independent convergent search processes of the database to occur in parallel, which greatly improves image match speed and match robustness in the Database Matching **36**. The Best Match **38** from either the Decode Symbol **28**, or the image Database Matching **36**, or both, is then determined. If a specific URL (or other online address) is associated with the image, then an URL Lookup **40** is performed and the Internet address is returned by the URL Return **42**.

[0049] The overall flow of the Input Image Decomposition process is as follows:

```
    Radiometric Correction
    Segmentation
    Segment Group Generation
    FOR each segment group
        Bounding Box Generation
        Geometric Normalization
        Wavelet Decomposition
        Color Cube Decomposition
        Shape Decomposition
        Low-Resolution Grayscale Image Generation
FOR END
```

[0050] Each of the above steps is explained in further detail below. For Radiometric Correction, the input image typically is transformed to an 8-bit per color plane, RGB representation. The RGB image is radiometrically normalized in all three channels. This normalization is accomplished by linear gain and offset transformations that result in the pixel values within each color channel spanning a full 8-bit dynamic range (256 possible discrete values). An 8-bit dynamic range is adequate but, of course, as optical capture devices produce higher resolution images and computers get faster and memory gets cheaper, higher bit dynamic ranges, such as 16-bit, 32-bit or more may be used.

[0051] For Segmentation, the radiometrically normalized RGB image is analyzed for "segments," or regions of similar color, i.e. near equal pixel values for red, green, and blue. These segments are defined by their boundaries, which consist of sets of (x, y) point pairs. A map of segment boundaries is produced, which is maintained separately from the RGB input image and is formatted as an x, y binary image map of the same aspect ratio as the RGB image.

[0052] For Segment Group Generation, the segments are grouped into all possible combinations. These groups are known as "segment groups" and represent all possible potential images or objects of interest in the input image. The segment groups are sorted based on the order in which they will be evaluated. Various evaluation order schemes are possible. The particular embodiment explained herein utilizes the following "center-out" scheme: The first segment group comprises only the segment that includes the center of the image. The next segment group comprises the previous segment plus the segment which is the largest (in number of pixels) and which is adjacent to (touching) the previous segment group. Additional segments are added using the segment criteria above until no segments remain. Each step, in which a new segment is added, creates a new and unique segment group.

[0053] For Bounding Box Generation, the elliptical major axis of the segment group under consideration (the major axis of an ellipse just large enough to contain the entire segment group) is computed. Then a rectangle is constructed within the image coordinate system, with long sides parallel to the elliptical major axis, of a size just large enough to completely contain every pixel in the segment group.

[0054] For Geometric Normalization, a copy of the input image is modified such that all pixels not included in the segment group under consideration are set to mid-level gray. The result is then resampled and mapped into a "standard aspect" output test image space such that the corners of the bounding box are mapped into the corners of the output test image. The standard aspect is the same size and aspect ratio as the Reference images used to create the database.

[0055] For Wavelet Decomposition, a grayscale representation of the full-color image is produced from the geometrically normalized image that resulted from the Geometric Normalization step. The following procedure is used to derive the grayscale representation. Reduce the three color planes into one grayscale image by proportionately adding each R, G, and B pixel of the standard corrected color image using the following formula:

$$L_{x,y}=0.34*R_{x,y}+0.55*G_{x,y}+0.11*B_{x,y}$$

then round to nearest integer value. Truncate at 0 and 255, if necessary. The resulting matrix L is a standard grayscale image. This grayscale representation is at the same spatial resolution as the full color image, with an 8-bit dynamic range. A multi-resolution Wavelet Decomposition of the grayscale image is performed, yielding wavelet coefficients for several scale factors. The Wavelet coefficients at various scales are ranked according to their weight within the image.

[0056] For Color Cube Decomposition, an image segmentation is performed (see "Segmentation" above), on the RGB image that results from Geometric Normalization. Then the RGB image is transformed to a normalized Intensity, Inphase and Quadrature-phase color image (YIQ). The segment map is used to identify the principal color regions of the image, since each segment boundary encloses pixels of similar color. The average Y, I, and Q values of each segment, and their individual component standard deviations, are computed. The following set of parameters result, representing the colors, color variation, and size for each segment:

[0057] Y_{avg}=Average Intensity

[0058] I_{avg}=Average In-phase

[0059] Q_{avg}=Average Quadrature

[0060] Y_{sigma}=Intensity standard deviation

[0061] I_{sigma}=In-phase standard deviation

[0062] Q_{sigma}=Quadrature standard deviation

[0063] N_{pixels}=number of pixels in the segment

[0064] The parameters comprise a representation of the color intensity and variation in each segment. When taken together for all segments in a segment group, these parameters comprise points (or more accurately, regions, if the standard deviations are taken into account) in a three-dimensional color space and describe the intensity and variation of color in the segment group.

[0065] For Shape Decomposition, the map resulting from the segmentation performed in the Color Cube Generation step is used and the segment group is evaluated to extract the group outer edge boundary, the total area enclosed by the boundary, and its area centroid. Additionally, the net ellipticity (semi-major axis divided by semi-minor axis of the closest fit ellipse to the group) is determined.

[0066] For Low-Resolution Grayscale Image Generation, the full-resolution grayscale representation of the image that was derived in the Wavelet Generation step is now subsampled by a factor in both x and y directions. For the example of this embodiment, a 3:1 subsampling is assumed. The subsampled image is produced by weighted averaging of pixels within each 3×3 cell. The result is contrast binned, by reducing the number of discrete values assignable to each pixel based upon substituting a "binned average" value for all pixels that fall within a discrete (TBD) number of brightness bins.

[0067] The above discussion of the particular decomposition methods incorporated into this embodiment are not intended to indicate that more, or alternate, decomposition methods may not also be employed within the context of this invention.

[0068] In other words:

```
FOR each input image segment group
    FOR each database object
        FOR each view of this object
            FOR each segment group in this view of this
            database object
                Shape Comparison
                Grayscale Comparison
                Wavelet Comparison
                Color Cube Comparison
                Calculate Combined Match Score
            END FOR
        END FOR
    END FOR
END FOR
```

Each of the above steps is explained in further detail below.

FOR Each Input Image Segment Group

[0069] This loop considers each combination of segment groups in the input image, in the order in which they were sorted in the "Segment Group Generation" step. Each segment group, as it is considered, is a candidate for the object of interest in the image, and it is compared against database objects using various tests.

[0070] One favored implementation, of many possible, for the order in which the segment groups are considered within this loop is the "center-out" approach mentioned previously in the "Segment Group Generation" section. This scheme considers segment groups in a sequence that represents the addition of adjacent segments to the group, starting at the center of the image. In this scheme, each new group that is considered comprises the previous group plus one additional adjacent image segment. The new group is compared against the database. If the new group results in a higher database matching score than the previous group, then new group is retained. If the new group has a lower matching score then the previous group, then it is discarded and the loop starts again. If a particular segment group results in a match score which is extremely high, then this is considered to be an exact match and no further searching is warranted; in this case the current group and matching database group are selected as the match and this loop is exited.

FOR Each Database Object

[0071] This loop considers each object in the database for comparison against the current input segment group.

FOR Each View of this Object

[0072] This loop considers each view of the current database object, for comparison against the current input segment group. The database contains, for each object, multiple views from different viewing angles.

FOR Each Segment Group in this View of this Database Object

[0073] This loop considers each combination of segment groups in the current view of the database object. These segment groups were created in the same manner as the input image segment groups.

Shape Comparison

Inputs:

[0074] For the input image and all database images:

[0075] I. Segment group outline

[0076] II. Segment group area

[0077] III. Segment group centroid location

[0078] IV. Segment group bounding ellipse ellipticity

Algorithm:

[0079] V. Identify those database segment groups with an area approximately equal to that of the input segment group, within TBD limits, and calculate an area matching score for each of these "matches."

[0080] VI. Within the set of matches identified in the previous step, identify those database segment groups with an ellipticity approximately equal to that of the input segment group, within TBD limits, and calculate an ellipticity position matching score for each of these "matches."

[0081] VII. Within the set of matches identified in the previous step, identify those database segment groups with a centroid position approximately equal to that of the input segment group, within TBD limits, and calculate a centroid position matching score for each of these "matches."

[0082] VIII. Within the set of matches identified in the previous step, identify those database segment groups with an outline shape approximately equal to that of the input segment group, within TBD limits, and calculate an outline matching score for each of these "matches." This is done by comparing the two outlines and analytically determining the extent to which they match.

Note: this algorithm need not necessarily be performed in the order of Steps 1 to 4. It could alternatively proceed as follows:

```
FOR each database segment group
    IF the group passes Step 1
        IF the group passes Step 2
```

-continued

```
            IF the group passes Step 3
                IF the group passes Step 4
                    Successful comparison, save
                    result
                END IF
            END IF
        END IF
    END IF
END FOR
```

Grayscale Comparison

Inputs:

[0083] For the input image and all database images:

[0084] IX. Low-resolution, normalized, contrast-binned, grayscale image of pixels within segment group bounding box, with pixels outside of the segment group set to a standard background color.

Algorithm:

[0085] Given a series of concentric rectangular "tiers" of pixels within the low-resolution images, compare the input image pixel values to those of all database images. Calculate a matching score for each comparison and identify those database images with matching scores within TBD limits, as follows:

```
FOR each database image
    FOR each tier, starting with the innermost and
    progressing to the outermost
        Compare the pixel values between the input and
        database image
        Calculate an aggregate matching score
        IF matching score is greater than some TBD limit
        (i.e., close match)
            Successful comparison, save result
        END IF
    END FOR
END FOR
```

Wavelet Comparison

Inputs:

[0086] For the input image and all database images:

[0087] X. Wavelet coefficients from high-resolution grayscale image within segment group bounding box.

Algorithm:

[0088] Successively compare the wavelet coefficients of the input segment group image and each database segment group image, starting with the lowest-order coefficients and progressing to the highest order coefficients. For each comparison, compute a matching score. For each new coefficient, only consider those database groups that had matching scores, at the previous (next lower order) coefficient within TBD limits.

```
FOR each database image
    IF input image C0 equals database image C0 within TBD
```

-continued

```
        limit
            IF input image C1 equals database image C1 within
            TBD limit
                ...
                IF input image CN equals database image CN
                within TBD limit
                    Close match, save result and match
                    score
                END IF
                ...
            END IF
        END IF
    END FOR
```

Notes:
I. "C_i" are the wavelet coefficients, with C_0 being the lowest order coefficient and C_N being the highest.
II. When the coefficients are compared, they are actually compared on a statistical (e.g. Gaussian) basis, rather than an arithmetic difference.
III. Data indexing techniques are used to allow direct fast access to database images according to their C_i values. This allows the algorithm to successively narrow the portions of the database of interest as it proceeds from the lowest order terms to the highest.

Color Cube Comparison

Inputs:

[0089] [Y_{avg}, I_{avg}, Q_{avg}, Ysigma, I_{sigma}, Q_{sigma}, Npixels] data sets ("Color Cube Points") for each segment in:

[0090] I. The input segment group image

[0091] II. Each database segment group image

Algorithm:

[0092]

```
FOR each database image
    FOR each segment group in the database image
        FOR each Color Cube Point in database segment group,
        in order of descending Npixels value
            IF Gaussian match between input (Y,I,Q) and
            database (Y,I,Q)
                I.   Calculate match score for this segment
                II.   Accumulate segment match score into
                  aggregate match score for segment group
                III.   IF aggregate matching score is greater than
                  some TBD limit (i.e., close match)
                    Successful comparison, save result
            END IF
        END FOR
    END FOR
END FOR
```

Notes:
I. The size of the Gaussian envelope about any Y, I, Q point is determined by RSS of standard deviations of Y, I, and Q for that point.

Calculate Combined Match Score

[0093] The four Object Image comparisons (Shape Comparison, Grayscale Comparison, Wavelet Comparison, Color Cube Comparison) each return a normalized matching score. These are independent assessments of the match of salient features of the input image to database images. To minimize the effect of uncertainties in any single comparison process, and to thus minimize the likelihood of returning a false match, the following root sum of squares relationship is used to combine the results of the individual comparisons into a combined match score for an image: CurrentMatch=SQRT ($W_{OC}M_{OC}^2+W_{CCC}M_{CCC}^2+W_{WC}M_{WC}^2+W_{SGC}M_{SGC}^2$), where Ws are TBD parameter weighting coefficients and Ms are the individual match scores of the four different comparisons.

[0094] The unique database search methodology and subsequent object match scoring criteria are novel aspects of the present invention that deserve special attention. Each decomposition of the Reference image and Input image regions represent an independent characterization of salient characteristics of the image. The Wavelet Decomposition, Color Cube Decomposition, Shape Decomposition, and evaluation of a sub-sampled low-resolution Grayscale representation of an input image all produce sets of parameters that describe the image in independent ways. Once all four of these processes are completed on the image to be tested, the parameters provided by each characterization are compared to the results of identical characterizations of the Reference images, which have been previously calculated and stored in the database. These comparisons, or searches, are carried out in parallel. The result of each search is a numerical score that is a weighted measure of the number of salient characteristics that "match" (i.e. that are statistically equivalent). Near equivalencies are also noted, and are counted in the cumulative score, but at a significantly reduced weighting.

[0095] One novel aspect of the database search methodology in the present invention is that not only are these independent searches carried out in parallel, but also, all but the low-resolution grayscale compares are "convergent." By convergent, it is meant that input image parameters are searched sequentially over increasingly smaller subsets of the entire database. The parameter carrying greatest weight from the input image is compared first to find statistical matches and near-matches in all database records. A normalized interim score (e.g., scaled value from zero to one, where one is perfect match and zero is no match) is computed, based on the results of this comparison. The next heaviest weighted parameter from the input image characterization is then searched on only those database records having initial interim scores above a minimum acceptable threshold value. This results in an incremental score that is incorporated into the interim score in a cumulative fashion. Then, subsequent compares of increasingly lesser-weighted parameters are assessed only on those database records that have cumulative interim scores above the same minimum acceptable threshold value in the previous accumulated set of tests.

[0096] This search technique results in quick completion of robust matches, and establishes limits on the domain of database elements that will be compared in a subsequent combined match calculation and therefore speeds up the process. The convergent nature of the search in these comparisons yields a ranked subset of the entire database.

[0097] The result of each of these database comparisons is a ranking of the match quality of each image, as a function of decomposition search technique. Only those images with final cumulative scores above the acceptable match threshold will be assessed in the next step, a Combined Match Score evaluation.

[0098] Four database comparison processes, Shape Comparison, Grayscale Comparison, Wavelet Comparison, and Color Cube Comparison, are performed. These processes may occur sequentially, but generally are preferably performed in parallel on a parallel computing platform. Each comparison technique searches the entire image database and returns those images that provide the best matches, for the particular algorithm, along with the matching scores for these images. These comparison algorithms are performed on segment groups, with each input image segment group being compared to each segment group for each database image.

[0099] FIGS. **3**A and **3**B show the process flow within the Database Matching operation. The algorithm is presented here as containing four nested loops with four parallel processes inside the innermost loop. This structure is for presentation and explanation only. The actual implementation, although performing the same operations at the innermost layer, can have a different structure in order to achieve the maximum benefit from processing speed enhancement techniques such as parallel computing and data indexing techniques. It is also important to note that the loop structures can be implemented independently for each inner comparison, rather than the shared approach shown in the FIGS. **3**A and **3**B.

[0100] Preferably, parallel processing is used to divide tasks between multiple CPUs (Central Processing Units) and/or computers. The overall algorithm may be divided in several ways, such as:

Sharing the Outer Loop:	In this technique, all CPUs run the entire algorithm, including the outer loop, but one CPU runs the loop for the first N cycles, another CPU for the second N cycles, all simultaneously.
Sharing the Comparisons:	In this technique, one CPU performs the loop functions. When the comparisons are performed, they are each passed to a separate CPU to be performed in parallel.
Sharing the Database:	This technique entails splitting database searches between CPUs, so that each CPU is responsible for searching one section of the database, and the sections are searched in parallel by multiple CPUs. This is, in essence, a form of the "Sharing the Outer Loop" technique described above.

Actual implementations can be some combination of the above techniques that optimizes the process on the available hardware.

[0101] Another technique employed to maximize speed is data indexing. This technique involves using a priori knowledge of where data resides to only search in those parts of the database that contain potential matches. Various forms of indexing may be used, such as hash tables, data compartmentalization (i.e., data within certain value ranges are stored in certain locations), data sorting, and database table indexing. An example of such techniques is, in the Shape Comparison algorithm (see below), if a database is to be searched for an entry with an Area with a value of A, the algorithm would know which database entries or data areas have this approximate value and would not need to search the entire database.

[0102] Another technique employed is as follows. FIG. **4** shows a simplified configuration of the invention. Boxes with solid lines represent processes, software, physical objects, or devices. Boxes with dashed lines represent information. The process begins with an object of interest: the target object **100**. In the case of consumer applications, the target object **100** could be, for example, beverage can, a music CD box, a DVD video box, a magazine advertisement, a poster, a theatre, a store, a building, a car, or any other object that user is interested in or wishes to interact with. In security applications the target object **100** could be, for example, a person, passport, or driver's license, etc. In industrial applications the target object **100** could be, for example, a part in a machine, a part on an assembly line, a box in a warehouse, or a spacecraft in orbit, etc.

[0103] The terminal **102** is a computing device that has an "image" capture device such as digital camera **103**, a video camera, or any other device that an convert a physical object into a digital representation of the object. The imagery can be a single image, a series of images, or a continuous video stream. For simplicity of explanation this document describes the digital imagery generally in terms of a single image, however the invention and this system can use all of the imagery types described above.

[0104] After the camera **103** captures the digital imagery of the target object **100**, image preprocessing **104** software converts the digital imagery into image data **105** for transmission to and analysis by an identification server **106**. Typically a network connection is provided capable of providing communications with the identification server **106**. Image data **105** is data extracted or converted from the original imagery of the target object **100** and has information content appropriate for identification of the target object **100** by the object recognition **107**, which may be software or hardware. Image data **105** can take many forms, depending on the particular embodiment of the invention. Examples of image data **105** are:

[0105] Compressed (e.g., JPEG2000) form of the raw imagery from camera **103**;

[0106] Key image information, such as spectral and/or spatial frequency components (e.g. wavelet components) of the raw imagery from camera **103**; and

[0107] MPEG video stream created from the raw imagery from camera **103**;

[0108] The particular form of the image data **105** and the particular operations performed in image preprocessing **104** depend on:

[0109] Algorithm and software used in object recognition **107** Processing power of terminal **102**;

[0110] Network connection speed between terminal **102** and identification server **106**;

[0111] Application of the System; and

[0112] Required system response time;

[0113] In general, there is a tradeoff between the network connection speed (between terminal **102** and identification server **106**) and the processing power of terminal **102**. The results all of the above tradeoffs will define the nature of image preprocessing **104** and image data **105** for a specific embodiment. For example, image preprocessing **104** could be image compression and image data **105** compressed imagery, or image preprocessing **104** could be wavelet analysis and image data **105** could be wavelet coefficients.

[0114] The image data **105** is sent from the terminal **102** to the identification server **106**. The identification server **106** receives the image data **105** and passes it to the object recognition **107**.

[0115] The identification server **106** is a set of functions that usually will exist on computing platform separate from the terminal **102**, but could exist on the same computing platform. If the identification server **106** exists on a separate computing device, such as a computer in a data center, then the transmission of the image components **105** to the identification server **106** is accomplished via a network or combination of networks, such a cellular telephone network, wireless Internet, Internet, and wire line network. If the identification server **106** exists on the same computing device as the terminal **102** then the transmission consists simply of a transfer of data from one software component or process to another.

[0116] Placing the identification server **106** on a computing platform separate from the terminal **102** enables the use of powerful computing resources for the object recognition **107** and database **108** functions, thus providing the power of these computing resources to the terminal **102** via network connection. For example, an embodiment that identifies objects out of a database of millions of known objects would be facilitated by the large storage, memory capacity, and processing power available in a data center; it may not be feasible to have such computing power and storage in a mobile device. Whether the terminal **102** and the identification server **106** are on the same computing platform or separate ones is an architectural decision that depends on system response time, number of database records, image recognition algorithm computing power and storage available in terminal **102**, etc., and this decision must be made for each embodiment of the invention. Based on current technology, in most embodiments these functions will be on separate computing platforms.

[0117] The overall function of the identification server **106** is to determine and provide the target object information **109** corresponding to the target object **100**, based on the image data **105**.

[0118] The object recognition **107** and the database **108** function together to:

- **[0119]** 1. Detect, recognize, and decode symbols, such as barcodes or text, in the image.
- **[0120]** 2. Recognize the object (the target object **100**) in the image.
- **[0121]** 3. Provide the target object information **109** that corresponds to the target object **100**. The target object information **109** usually (depending on the embodiment) includes an information address corresponding to the target object **100**.

[0122] The object recognition **107** detects and decodes symbols, such as barcodes or text, in the input image. This is accomplished via algorithms, software, and/or hardware components suited for this task. Such components are commercially available (The HALCON software package from MVTec is an example). The object recognition **107** also detects and recognizes images of the target object **100** or portions thereof. This is accomplished by analyzing the image data **105** and comparing the results to other data, representing images of a plurality of known objects, stored in the database **108**, and recognizing the target object **100** if a representation of target object **100** is stored in the database **108**.

[0123] In some embodiments the terminal **102** includes software, such as a web browser (the browser **110**), that receives an information address, connects to that information address via a network or networks, such as the Internet, and exchanges information with another computing device at that information address. In consumer applications the terminal **102** may be a portable cellular telephone or Personal Digital Assistant equipped with a camera **103** and wireless Internet connection. In security and industrial applications the terminal **102** may be a similar portable hand-held device or may be fixed in location and/or orientation, and may have either a wireless or wire line network connection.

[0124] Other object recognition techniques also exist and include methods that store 3-dimensional models (rather than 2-dimensional images) of objects in a database and correlate input images with these models of the target object is performed by an object recognition technique of which many are available commercially and in the prior art. Such object recognition techniques usually consist of comparing a new input image to a plurality of known images and detecting correspondences between the new input image and one of more of the known images. The known images are views of known objects from a plurality of viewing angles and thus allow recognition of 2-dimensional and 3-dimensional objects in arbitrary orientations relative to the camera **103**.

[0125] FIG. **4** shows the object recognition **107** and the database **108** as separate functions for simplicity. However, in many embodiments the object recognition **107** and the database **108** are so closely interdependent that they may be considered a single process.

[0126] There are various options for the object recognition technique and the particular processes performed within the object recognition **107** and the database **108** depend on this choice. The choice depends on the nature, requirements, and architecture of the particular embodiment of the invention. However, most embodiments will usually share most of the following desired attributes of the image recognition technique:

- **[0127]** Capable of recognizing both 2-dimensional (i.e., flat) and 3-dimensional objects;
- **[0128]** Capable of discriminating the target object **100** from any foreground or background objects or image information, i.e., be robust with respect to changes in background;
- **[0129]** Fast;
- **[0130]** Autonomous (no human assistance required in the recognition process);
- **[0131]** Scalable; able to identify objects from a large database of known objects with short response time; and
- **[0132]** Robust with respect to:
  - **[0133]** Affine transformations (rotation, translation, scaling);
  - **[0134]** Non-affine transformations (stretching, bending, breaking);
  - **[0135]** Occlusions (of the target object **100**);
  - **[0136]** Shadows (on the target object **100**);
  - **[0137]** Reflections (on the target object **100**);
  - **[0138]** Variations in light color temperature;
  - **[0139]** Image noise;
  - **[0140]** Capable of determining position and orientation of the target object **100** in the original imagery; and
  - **[0141]** Capable of recognizing individual human faces from a database containing data representing a large plurality of human faces.

[0142] All of these attributes do not apply to all embodiments. For example, consumer linking embodiments generally do not require determination of position and orientation of the target object **100**, while a spacecraft target position and orientation determination system generally would not be required to identify human faces or a large number of different objects.

[0143] It is usually desirable that the database **108** be scalable to enable identification of the target object **100** from a very large plurality (for example, millions) of known objects in the database **108**. The algorithms, software, and computing hardware must be designed to function together to quickly perform such a search. An example software technique for performing such searching quickly is to use a metric distance comparison technique for comparing the image data **105** to data stored in the database **108**, along with database clustering and multiresolution distance comparisons. This technique is described in "Fast Exhaustive Multi-Resolution Search Algorithm Based on Clustering for Efficient Image Retrieval," by Song, Kim, and Ra, 2000.

[0144] In addition to such software techniques, a parallel processing computing architecture may be employed to achieve fast searching of large databases. Parallel processing is particularly important in cases where a non-metric distance is used in object recognition **107**, because techniques such database clustering and multiresolution search may not be possible and thus the complete database must be searched by partitioning the database across multiple CPUs.

[0145] As described above, the object recognition **107** can also detect identifying marks on the target object **100**. For example, the target object **100** may include an identifying number or a barcode. This information can be decoded and used to identify or help identify the target object **100** in the database **108**. This information also can be passed on as part of the target object information **109**. If the information is included as part of the target object information **109** then it can be used by the terminal **102** or content server **111** to identify the specific target object **100**, out of many such objects that have similar appearance and differ only in the identifying marks. This technique is useful, for example, in cases where the target object **100** is an active device with a network connection (such as a vending machine) and the content server establishes communication with the target object **100**. A combination with a Global Positioning System can also be used to identify like objects by their location.

[0146] The object recognition **107** may be implemented in hardware, software, or a combination of both. Examples of each category are presented below.

[0147] Hardware object recognition implementations include optical correlators, optimized computing platforms, and custom hardware.

[0148] Optical correlators detect objects in images very rapidly by, in effect, performing image correlation calculations with light. Examples of optical correlators are:

- **[0149]** Litton Miniaturized Ruggedized Optical Correlator, from Northrop Grumman Corp;
- **[0150]** Hybrid Digital/Optical Correlator, from the School of Engineering and Information Technology, University of Sussex, UK; and
- **[0151]** OC-VGA3000 and OC-VGA6000 Optical Correlators from INO, Quebec, Canada.

[0152] Optimized computing platforms are hardware computing systems, usually on a single board, that are optimized to perform image processing and recognition algorithms very quickly. These platforms must be programmed with the object recognition algorithm of choice. Examples of optimized computing platforms are

- **[0153]** VIP/Balboa™ Image Processing Board, from Irvine Sensors Corp.; and

[0154] 3DANN™-R Processing System, from Irvine Sensors Corp.

[0155] Image recognition calculations can also be implemented directly in custom hardware in forms such as Application Specific Integrated Circuits (ASICs), Field Programmable Gate Arrays (FPGAs), and Digital Signal Processors (DSPs).

[0156] There are many object and image recognition software applications available commercially and many algorithms published in the literature. Examples of commercially available image/object recognition software packages include:

- **[0157]** Object recognition system, from Sandia National Laboratories;
- **[0158]** Object recognition perception modules, from Evolution Robotics;
- **[0159]** ImageFinder, from Attrasoft;
- **[0160]** ImageWare, from Roz Software Systems; and
- **[0161]** ID-2000, from Imagis Technologies.

[0162] Some of the above recognition systems include 3-dimensional object recognition capability while others perform 2-dimensional image recognition. The latter type are used to perform 3-dimensional object recognition by comparing input images to a plurality of 2-dimensional views of objects from a plurality of viewing angles.

[0163] Examples of object recognition algorithms in the literature and intended for implementation in software are:

- **[0164]** Distortion Invariant Object Recognition in the Dynamic Link Architecture, Lades et al, 1993;
- **[0165]** SEEMORE: Combining Color, Shape, and Texture Histogramming in a Neurally Inspired Approach to Visual Object Recognition, Mel, 1996;
- **[0166]** Probabilistic Affine Invariants for Recognition, Leung et al, 1998;
- **[0167]** Software Library for Appearance Matching (SLAM), Nene at al, 1994;
- **[0168]** Probabilistic Models of Appearance for 3-D Object Recognition, Pope & Lowe, 2000;
- **[0169]** Matching 3D Models with Shape Distributions, Osada et al, 2001;
- **[0170]** Finding Pictures of Objects in Large Collections of Images, Forsyth et al, 1996;
- **[0171]** The Earth Mover's Distance under Transformation Sets, Cohen & Guibas, 1999;
- **[0172]** Object Recognition from Local Scale-Invariant Features, Lowe, 1999; and
- **[0173]** Fast Object Recognition in Noisy Images Using Simulated Annealing, Betke & Makris, 1994.

[0174] Part of the current invention is the following object recognition algorithm specifically designed to be used as the object recognition **107** and, to some extent, the database **108**. This algorithm is robust with respect to occlusions, reflections, shadows, background/foreground clutter, object deformation and breaking, and is scalable to large databases. The task of the algorithm is to find an object or portion thereof in an input image, given a database of multiple objects with multiple views (from different angles) of each object.

[0175] This algorithm uses the concept of a Local Image Descriptor (LID) to summarize the information in a local region of an image. A LID is a circular subset, or "cutout," of a portion of an image. There are various formulations for LIDs; two examples are:

LID Formulation 1

- **[0176]** The area within the LID is divided into range and angle bins. The average color in each [range,angle] bin is calculated from the pixel values therein.

LID Formulation 2

- **[0177]** The area within the LID is divided into range bins. The color histogram values within each range bin are calculated from the pixel values therein. For each range bin, a measure of the variation of color with angle is calculated as, for example, the sum of the changes in average color between adjacent small angular slices of a range bin.

[0178] A LID in the input image is compared to a LID in a database image by a comparison technique such the L1 Distance, L2 Distance, Unfolded Distance, Earth Mover Distance, or cross-correlation. Small distances indicate a good match between the portions of the images underlying the LIDS. By iteratively changing the position and size of the LIDs in the input and database images the algorithm converges on the best match between circular regions in the 2 images.

[0179] Limiting the comparisons to subsets (circular LIDs) of the images enables the algorithm to discriminate an object from the background. Only LIDs that fall on the object, as opposed to the background, yield good matches with database images. This technique also enable matching of partially occluded objects; a LID that falls on the visible part of an occluded object will match to a LID in the corresponding location in the database image of the object.

[0180] The iteration technique used to find the best match is simulated annealing, although genetic search, steepest descent, or other similar techniques appropriate for multivariable optimization can also be used individually or in combination with simulated annealing. Simulated annealing is modeled after the concept of a molten substance cooling and solidifying into a solid. The algorithm starts at a given temperature and then the temperature is gradually reduced with time. At each time step, the values of the search variables are perturbed from the their previous values to a create a new "child" generation of LIDs. The perturbations are calculated statistically and their magnitudes are functions of the temperature. As the temperature decreases the perturbations decrease in size. The child LIDs, in the input and database images, are then compared. If the match is better than that obtained with the previous "parent" generation, then a statistical decision is made regarding to whether to accept or reject the child LIDs as the current best match. This is a statistical decision that is a function of both the match distance and the temperature. The probability of child acceptance increases with temperature and decreases with match distance. Thus, good matches (small match distance) are more likely to be accepted but poor matches can also be accepted occasionally. The latter case is more likely to occur early in the process when the temperature is high. Statistical acceptance of poor matches is included to allow the algorithm to "jump" out of local minima.

[0181] When LID Formulation 1 is used, the rotation angle of the LID need not necessarily be a simulated annealing search parameter. Faster convergence can be obtained by performing a simple step-wise search on rotation to find the best orientation (within the tolerance of the step size) within each simulated annealing time step.

[0182] The search variables, in both the input and database images, are:

[0183] LID x-position;

[0184] LID y-position;

[0185] LID radius;

[0186] LID x-stretch;

[0187] LID y-stretch; and

[0188] LID orientation angle (only for LID Formulation 1).

[0189] LID x-stretch and LID y-stretch are measures of "stretch" distortion applied to the LID circle, and measure the distortion of the circle into an oval. This is included to provide robustness to differences in orientation and curvature between the input and database images.

[0190] The use of multiple simultaneous LIDs provides additional robustness to occlusions, shadows, reflections, rotations, deformations, and object breaking. The best matches for multiple input image LIDS are sought throughout the database images. The input image LIDS are restricted to remain at certain minimum separation distances from each other. The minimum distance between any 2 LIDs centers is a function of the LID radii. The input image LIDS converge and settle on the regions of the input image having the best correspondence to any regions of any database images. Thus the LIDs behave in the manner of marbles rolling towards the lowest spot on a surface, e.g., the bottom of a bowl, but being held apart by their radius (although LIDS generally have minimum separation distances that are less than their radii).

[0191] In cases where the object in the input image appears deformed or curved relative to the known configuration in which it appears in the database, multiple input image LIDS will match to different database images. Each input image LID will match to that database image which shows the underlying portion of the object as it most closely resembles the input image. If the input image object is bent, e.g., a curved poster, then one part will match to one database orientation and another part will match to a different orientation.

[0192] In the case where the input image object appears to be broken into multiple pieces, either due to occlusion or to physical breakage, use of multiple LIDs again provides robust matching: individual LIDs "settle" on portions of the input image object as they match to corresponding portions of the object in various views in the database.

[0193] Robustness with respect to shadows and reflections is provided by LIDs simply not detecting good matches on these input image regions. They are in effect accommodated in the same manner as occlusions.

[0194] Robustness with respect to curvature and bending is accommodated by multiple techniques. First, use of multiple LIDs provides such robustness as described above. Secondly, curvature and bending robustness is inherently provided to some extent within each LID by use of LID range bin sizes that increase with distance from the LID center (e.g., logarithmic spacing). Given matching points in an input image and database image, deformation of the input image object away from the plane tangent at the matching point increases with distance from the matching point. The larger bin sizes of the outer bins (in both range and angle) reduce this sensitivity because they are less sensitive to image shifts.

[0195] Robustness with respect to lighting color temperature variations is provided by normalization of each color channel within each LID.

[0196] Fast performance, particular with large databases, can be obtained through several techniques, as follows:

[0197] 1. Use of LID Formulation 2 can reduce the amount of search by virtue of being rotationally invariant, although this comes at the cost of some robustness due to loss of image information.

[0198] 2. If a metric distance (e.g., L1, L2, or Unfolded) is used for LID comparison, then database clustering, based on the triangle inequality, can be used to rule out large portions of the database from searching. Since database LIDs are created during the execution of the algorithm, the run-time database LIDs are not clustered. Rather, during preparation of the database, sample LIDs are created from the database images by sampling the search parameters throughout their valid ranges. From this data, bounding clusters can be created for each image and for portions of images. With this information the search algorithm can rule out portions of the search parameter space.

[0199] 3. If a metric distance is used, then progressive multiresolution search can be used. This technique saves time by comparing data first at low resolution and only proceeds with successive higher-resolution comparison on candidates with correlations better than the current best match. A discussion of this technique, along with database clustering, can be found in "Fast Exhaustive Multi-Resolution Search Algorithm Based on Clustering for Efficient Image Retrieval," by Song et al, 2000.

[0200] 4. The parameter search space and number of LIDs can be limited. Bounds can be placed, for example, on the sizes of LIDs depending on the expected sizes of input image objects relative to those in the database. A small number of LIDs, even 1, can be used, at the expense of some robustness.

[0201] 5. LIDs can be fixed in the database images. This eliminates iterative searching on database LID parameters, at the expense of some robustness.

[0202] 6. The "x-stretch" and "y-stretch" search parameters can be eliminated, although there is a trade-off between these search parameters and the number of database images. These parameters increase the ability to match between images of the same object in different orientations. Elimination of these parameters may require more database images with closer angular spacing, depending on the particular embodiment.

[0203] 7. Parallel processing can be utilized to increase computing power.

[0204] This technique is similar to that described by Betke & Makris in "Fast Object Recognition in Noisy Images Using Simulated Annealing", 1994, with the following important distinctions:

[0205] The current algorithm is robust with respect to occlusion. This is made possible by varying size and position of LIDs in database images, during the search process, in order to match non-occluded portions of database images.

[0206] The current algorithm can identify 3-dimensional objects by containing views of objects from many orientations in the database.

[0207] The current algorithm uses database clustering to enable rapid searching of large databases.

[0208] The current algorithm uses circular LIDs.

[0209] In addition to containing image information, the database **108** also contains address information. After the target object **100** has been identified, the database **108** is searched to find information corresponding to the target object **100**. This information can be an information address, such as an Internet URL. The identification server **106** then sends this information, in the form of the target object information **109**, to the terminal **102**. Depending on the particular embodiment of the invention, the target object information **109** may include, but not be limited to, one or more of the following items of information pertaining to the target object **100**:

[0210] Information address (e.g., Internet URL)

[0211] Identity (e.g., object name, number, classification, etc.);

[0212] Position;

[0213] Orientation;

[0214] Size;

[0215] Color;

[0216] Status;

[0217] Information decoded from and/or referenced by symbols (e.g. information coded in a barcode or a URL referenced by such a barcode); and

[0218] Other data (e.g. alphanumerical text)

[0219] Thus, the identification server determines the identity and/or various attributes of the target object **100** from the image data **105**.

[0220] The target object information **109** is sent to the terminal **102**. This information usually flows via the same communication path used to send the image data **105** from the terminal **102** to the identification server **106**, but this is not necessarily the case. This method of this flow information depends on the particular embodiment of the invention.

[0221] The terminal **102** receives the target object information **109**. The terminal **102** then performs some action or actions based on the target object information **109**. This action or actions may include, but not be limited to:

[0222] Accessing a web site.

[0223] Accessing or initiating a software process on the terminal **102**.

[0224] Accessing or initiating a software process on another computer via a network or networks such as the Internet.

[0225] Accessing a web service (a software service accessed via the Internet).

[0226] Initiating a telephone call (if the terminal **102** includes such capability) to a telephone number that may be included in or determined by the target object Information, may be stored in the terminal **102**, or may be entered by the user.

[0227] Initiating a radio communication (if the terminal **102** includes such capability) using a radio frequency that may be included in or determined by the target object Information, may be stored in the terminal **102**, or may be entered by the user.

[0228] Sending information that is included in the target object information **109** to a web site, a software process (on another computer or on the terminal **102**), or a hardware component.

[0229] Displaying information, via the screen or other visual indication, such as text, graphics, animations, video, or indicator lights.

[0230] Producing an audio signal or sound, including playing music.

[0231] In many embodiments, the terminal **102** sends the target object information **109** to the browser **110**. The browser **110** may or may not exist in the terminal **102**, depending on the particular embodiment of the invention. The browser **110** is a software component, hardware component, or both, that is capable of communicating with and accessing information from a computer at an information address contained in target object information **109**.

[0232] In most embodiments the browser **110** will be a web browser, embedded in the terminal **102**, capable of accessing and communicating with web sites via a network or networks such as the Internet. In some embodiments, however, such as those that only involve displaying the identity, position, orientation, or status of the target object **100**, the browser **110** may be a software component or application that displays or provides the target object information **109** to a human user or to another software component or application.

[0233] In embodiments wherein the browser **110** is a web browser, the browser **110** connects to the content server **111** located at the information address (typically an Internet URL) included in the target object information **109**. This connection is effected by the terminal **102** and the browser **110** acting in concert. The content server **111** is an information server and computing system. The connection and information exchanged between the terminal **102** and the content server **111** generally is accomplished via standard Internet and wireless network software, protocols (e.g. HTTP, WAP, etc.), and networks, although any information exchange technique can be used. The physical network connection depends on the system architecture of the particular embodiment but in most embodiments will involve a wireless network and the Internet. This physical network will most likely be the same network used to connect the terminal **102** and the identification server **106**.

[0234] The content server **111** sends content information to the terminal **102** and browser **110**. This content information usually is pertinent to the target object **100** and can be text, audio, video, graphics, or information in any form that is usable by the browser **110** and terminal **102**. The terminal **102** and browser **110** send, in some embodiments, additional information to the content server **111**. This additional information can be information such as the identity of the user of the terminal **102** or the location of the user of the terminal **102** (as determined from a GPS system or a radio-frequency ranging system). In some embodiments such information is provided to the content server by the wireless network carrier.

[0235] The user can perform ongoing interactions with the content server **111**. For example, depending on the embodiment of the invention and the applications, the user can:

[0236] Listen to streaming audio samples if the target object **100** is an audio recording (e.g., compact audio disc).

[0237] Purchase the target object **100** via on-line transaction, with the purchase amount billed to an account linked to the terminal **102**, to the individual user, to a bank account, or to a credit card.

[0238] In some embodiments the content server **111** may reside within the terminal **102**. In such embodiments, the communication between the terminal **102** and the content server **111** does not occur via a network but rather occurs within the terminal **102**.

[0239] In embodiments wherein the target object **100** includes or is a device capable of communicating with other devices or computers via a network or networks such as the Internet, and wherein the target object information **109** includes adequate identification (such as a sign, number, or barcode) of the specific target object **100**, the content server **111** connects to and exchanges information with the target object **100** via a network or networks such as the Internet. In this type of embodiment, the terminal **102** is connected to the content server **111** and the content server **111** is connected to the target object **100**. Thus, the terminal **102** and target object **100** can communicate via the content server **111**. This enables the user to interact with the target object **100** despite the lack of a direct connection between the target object **100** and the terminal **102**.

[0240] The following are examples of embodiments of the invention.

[0241] FIG. **5** shows a preferred embodiment of the invention that uses a cellular telephone, PDA, or such mobile device equipped with computational capability, a digital camera, and a wireless network connection, as the terminal **202** corresponding to the terminal **102** in FIG. **4**. In this embodiment, the terminal **202** communicates with the identification server **206** and the content server **211** via networks such as a cellular telephone network and the Internet.

[0242] This embodiment can be used for applications such as the following ("User" refers to the person operating the terminal **202**, and the terminal **202** is a cellular telephone, PDA, or similar device, and "point and click" refers to the operation of the User capturing imagery of the target object **200** and initiating the transfer of the image data **205** to the identification server **206**).

[0243] The User "points and clicks" the terminal **202** at a compact disc (CD) containing recorded music or a digital video disc (DVD) containing recorded video. The terminal **202** browser connects to the URL corresponding to the CD or DVD and displays a menu of options from which the user can select. From this menu, the user can listen to streaming audio samples of the CD or streaming video samples of the DVD, or can purchase the CD or DVD.

[0244] The User "points and clicks" the terminal **202** at a print media advertisement, poster, or billboard advertising a movie, music recording, video, or other entertainment. The browser **210** connects to the URL corresponding to the advertised item and the user can listen to streaming audio samples, purchase streaming video samples, obtain show times, or purchase the item or tickets.

[0245] The User "points and clicks" the terminal **202** at a television screen to interact with television programming in real-time. For example, the programming could consist of a product promotion involving a reduced price during a limited time. Users that "point and click" on this television programming during the promotion are linked to a web site at which they can purchase the product at the promotional price. Another example is a interactive television programming in which users "point and click" on the television screen at specific times, based on the on-screen content, to register votes, indicate actions, or connect to a web site through which they perform real time interactions with the on-screen program.

[0246] The User "points and clicks" on an object such as a consumer product, an advertisement for a product, a poster, etc., the terminal **202** makes a telephone call to the company selling the product, and the consumer has a direct discussion with a company representative regarding the company's product or service. In this case the company telephone number is included in the target object information **209**. If the target object information **209** also includes the company URL then the User can interact with the company via both voice and Internet (via browser **210**) simultaneously.

[0247] The User "points and clicks" on a vending machine (target object **200**) that is equipped with a connection to a network such as the Internet and that has a unique identifying mark, such as a number. The terminal **202** connects to the content server **211** of the company that operates the vending machine. The identification server identifies the particular vending machine by identifying and decoding the unique identifying mark. The identity of the particular machine is included in the target object information **209** and is sent from the terminal **202** to the content server **211**. The content server **211**, having the identification of the particular vending machine (target object **200**), initiates communication with the vending machine. The User performs a transaction with the vending machine, such as purchasing a product, using his terminal **202** that communicates with the vending machine via the content server **211**.

[0248] The User "points and clicks" on part of a machine, such as an aircraft part. The terminal **202** then displays information pertinent to the part, such as maintenance instructions or repair history.

[0249] The User "points and clicks" on a magazine or newspaper article and link to streaming audio or video content, further information, etc.

[0250] The User "points and clicks" on an automobile. The location of the terminal **206** is determined by a Global Position System receiver in the terminal **206**, by cellular network radio ranging, or by another technique. The position of the terminal **202** is sent to the content server **211**. The content server provides the User with information regarding the automobile, such as price and features, and furthermore, based on the position information, provides the User with the location of a nearby automobile dealer that sells the car. This same technique can be used to direct Users to nearby retail stores selling items appearing in magazine advertisements that Users "point and click" on.

[0251] For visually impaired people:

[0252] Click on any item in a store and the device speaks the name of the item and price to you (the items must be in the database).

[0253] Click on a newspaper or magazine article and the device reads the article to you.

[0254] Click on a sign (building, streetsign, etc.) and the device reads the sign to you and provides any addition pertinent information (the signs must be in the database).

[0255] FIG. **6** shows an embodiment of the invention for spacecraft applications. In this embodiment, all components of the system (except the target object **300**) are onboard a Spacecraft. The target object **300** is another spacecraft or object. This embodiment is used to determine the position and orientation of the target object **300** relative to the Spacecraft so that this information can be used in navigating, guiding, and maneuvering the spacecraft relative to the target object **300**. An example use of this embodiment would be in autonomous spacecraft rendezvous and docking.

[0256] This embodiment determines the position and orientation of the target object **300**, relative to the Spacecraft, as determined by the position, orientation, and size of the target object **300** in the imagery captured by the camera **303**, by comparing the imagery with views of the target object **300** from different orientations that are stored in the database **308**. The relative position and orientation of the target object **300** are output in the target object information, so that the spacecraft data system **310** can use this information in planning trajectories and maneuvers.

INDUSTRIAL APPLICABILITY

[0257] The industrial applicability is anywhere that objects are to be identified by a digital optical representation of the object.

1-11. (canceled)

12. A method for identifying an object in an at least one given image including:

iteratively comparing at least one region in the at least one given image with regions in images in an at least one database until the best correspondence is found between the at least one region in the at least one given image and the at least one region in images in the at least one database; wherein the images in the least one database represent views of at least one object in at least one viewing orientation, wherein the comparing is performed by:

extracting and comparing parameters from the regions of the at least one given image and the images in the at least one database.

13. The method for identifying an object in an at least one given image as defined in claim **12** including:

a method for reducing the number of required comparisons, which includes:

determining a priori that there is poor correspondence between the at least one region in the at least one given image and certain images in the at least one database.

14. The method for identifying an object in an at least one given image as defined in claim **12** including:

capturing at least one image; and

providing communications or information that are determined by both the identity of the object and the location of the device used to capture the at least one image, based both on the identity of the object and on refining or modifying the set of candidate identities of the at least one object based on the location of the device used to capture the at least one image.

15. The method for identifying an object in an at least one given image as defined in claim **12** further including:

establishing a connection between a portable device and an information site pertinent to an object by:

determining the address of the information site corresponding to the object using a remote computer, sending the address to the portable device, and connecting to the information site via at least one network.

16. The method for identifying an object in an at least one given image as defined in claim **12** further including:

providing audio information pertinent to at least one object based on capturing at least one image of the at least one object with a portable device,

recognizing the at least one object using the portable device or a remote computer; and

providing the pertinent audio information to the portable device.

17-21. (canceled)

* * * * *

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☐ Declaration Submitted With Initial Filing **OR** ☒ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	101044.0001US2
First Named Inventor	Wayne C. Boncyk
COMPLETE IF KNOWN	
Application Number	10/492,243
Filing Date	April 9, 2004
Art Unit	
Examiner Name	

I hereby declare that:

Each inventor's residence, mailing address, and citizenship are as stated below next to their name.

I believe the inventor(s) named below to be the original and first inventor(s) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Image Capture and Identification System and Process

(Title of the Invention)

the specification of which

☐ is attached hereto

OR

☒ was filed on (MM/DD/YYYY) 11/05/2002 as United States Application Number or PCT International Application Number PCT/US02/35407 and was amended on (MM/DD/YYYY) 09/02/2003 (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent, inventor's or plant breeder's rights certificate(s), or any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? Yes	No
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

DECLARATION — Utility or Design Patent Application

Direct all correspondence to: [X] Customer Number: 34284	OR [ ] Correspondence address below		
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

NAME OF SOLE OR FIRST INVENTOR:	[ ] A petition has been filed for this unsigned inventor		
Given Name (first and middle [if any]) Wayne C.		Family Name or Surname Boncyk	
Inventor's Signature Wayne C. Boncyk			Date 11 Feb., 2009
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NAME OF SECOND INVENTOR:	[ ] A petition has been filed for this unsigned inventor		
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City Pasadena	State CA	ZIP 91107	Country US

[ ] Additional inventors or a legal representative are being named on the ______ supplemental sheet(s) PTO/SB/02A or 02LR attached hereto.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	Image Capture and Identification System and Process
First Named Inventor/Applicant Name:	Wayne C. Boncyk
Filer:	Martin Fessenmaier/Lindsey Ripley
Attorney Docket Number:	101044.0001US14

Filed as Large Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility application filing	1011	1	330	330
Utility Search Fee	1111	1	540	540
Utility Examination Fee	1311	1	220	220
Pages:				
Claims:				
Claims in excess of 20	1202	18	52	936
Miscellaneous-Filing:				
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**2026**

Electronic Acknowledgement Receipt

EFS ID:	9715072
Application Number:	13069124
International Application Number:	
Confirmation Number:	9532
Title of Invention:	Image Capture and Identification System and Process
First Named Inventor/Applicant Name:	Wayne C. Boncyk
Customer Number:	24392
Filer:	Martin Fessenmaier/Lindsey Ripley
Filer Authorized By:	Martin Fessenmaier
Attorney Docket Number:	101044.0001US14
Receipt Date:	22-MAR-2011
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Time Stamp:	17:44:03
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$2026
RAM confirmation Number	4582
Deposit Account	500341
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	US_ADS_Form_SB_14.pdf	965202 c2810b730b82c0d72e86237376cf2e74b3d6004c	no	5
Warnings:					
Information:					
2	Preliminary Amendment	Preliminary_Amendment_01a_1US14.pdf	77295 0f5c09c3762c2238844ebcd46d84ee644c12401c	no	6
Warnings:					
Information:					
3	Miscellaneous Incoming Letter	1US7_publication.pdf	358492 14254295dd7db405ae2768489e282d2d7b116f00	no	21
Warnings:					
Information:					
4	Oath or Declaration filed	DECLARATION_signed.pdf	155080 b7f2f5ea0de9b707de26546eb296156d98525f7e	no	2
Warnings:					
Information:					
5	Fee Worksheet (PTO-875)	fee-info.pdf	36357 a2edfddb728e76c3ce9512b5c9fbe27b18bff8f5	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	1592426	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	101044.0001US14
	Application Number	
Title of Invention	Image Capture and Identification System and Process	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Applicant Information:

Applicant 1 Remove

Applicant Authority	◉ Inventor	○ Legal Representative under 35 U.S.C. 117	○ Party of Interest under 35 U.S.C. 118	
Prefix	**Given Name**	**Middle Name**	**Family Name**	**Suffix**
	Wayne	C.	Boncyk	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Evergreen	**State/Province**	CA	**Country of Residence** i	US
Citizenship under 37 CFR 1.41(b) i	US				

Mailing Address of Applicant:

Address 1	32059 Quarterhorse Road		
Address 2			
City	Evergreen	**State/Province**	CO
Postal Code	80439	**Country** i	US

Applicant 2 Remove

Applicant Authority	◉ Inventor	○ Legal Representative under 35 U.S.C. 117	○ Party of Interest under 35 U.S.C. 118	
Prefix	**Given Name**	**Middle Name**	**Family Name**	**Suffix**
	Ronald	H.	Cohen	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Pasadena	**State/Province**	CA	**Country of Residence** i	US
Citizenship under 37 CFR 1.41(b) i	US				

Mailing Address of Applicant:

Address 1	2445 E. Del Mar Blvd., #416		
Address 2			
City	Pasadena	**State/Province**	CA
Postal Code	91107	**Country** i	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	101044.0001US14
	Application Number	
Title of Invention	Image Capture and Identification System and Process	

☐ **An Address is being provided for the correspondence Information of this application.**		
Customer Number	24392	
Email Address	nwitchey@fishiplaw.com	Add Email / Remove Email

Application Information:

Title of the Invention	Image Capture and Identification System and Process		
Attorney Docket Number	101044.0001US14	**Small Entity Status Claimed**	☒
Application Type	Nonprovisional		
Subject Matter			
Suggested Class (if any)		**Sub Class (if any)**	
Suggested Technology Center (if any)			
Total Number of Drawing Sheets (if any)	7	**Suggested Figure for Publication (if any)**	2
Publication Information:			
☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)			
☐ Request Not to Publish. I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application has not been and will not be the subject of an application filed in another country, or under a multilateral agreement, that requires publication at eighteen months after filing.			

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Enter either Customer Number or complete the Representative Name section below. If both sections are completed the Customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ US Representative (37 CFR 11.9)
Customer Number	24392		

Domestic Priority Information:

This section allows for the applicant to claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c). Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78(a)(2) or CFR 1.78(a)(4), and need not otherwise be made part of the specification.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Division of	13/037317	2011-02-28
Prior Application Status	Pending		Remove

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	101044.0001US14
	Application Number	
Title of Invention	Image Capture and Identification System and Process	

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
13/037317	Division of	12/333630	2008-12-12
Prior Application Status	Patented		Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
12/333630	Division of	10/492243	2004-04-09	747780	2008-12-22
Prior Application Status	Expired				Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
12/333630	a 371 of international	PCT/US02/35047	2002-11-05
Prior Application Status	Patented		Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
PCT/US02/35047	Continuation of	09/992942	2001-11-05	7016532	2006-03-21
Prior Application Status	Expired				Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
09/992942	non provisional of	60/246295	2000-11-06
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
09/992942	non provisional of	60/317521	2001-09-05

Additional Domestic Priority Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim benefit of foreign priority and to identify any prior foreign application for which priority is not claimed. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(a).

Remove

Application Number	Country i	Parent Filing Date (YYYY-MM-DD)	Priority Claimed
			◉ Yes ○ No

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Assignee Information:

Providing this information in the application data sheet does not substitute for compliance with any requirement of part 3 of Title 37 of the CFR to have an assignment recorded in the Office.

Assignee 1 Remove

If the Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	101044.0001US14
	Application Number	
Title of Invention	Image Capture and Identification System and Process	

Mailing Address Information:			
Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			
Additional Assignee Data may be generated within this form by selecting the **Add** button.	Add		

Signature:

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 10.18. Please see 37 CFR 1.4(d) for the form of the signature.					
Signature	/Nicholas J. Witchey/			Date (YYYY-MM-DD)	2011-03-22
First Name	Nicholas J.	Last Name	Witchey	Registration Number	63481

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	9715072
Application Number:	13069124
International Application Number:	
Confirmation Number:	9532
Title of Invention:	Image Capture and Identification System and Process
First Named Inventor/Applicant Name:	Wayne C. Boncyk
Customer Number:	24392
Filer:	Martin Fessenmaier/Lindsey Ripley
Filer Authorized By:	Martin Fessenmaier
Attorney Docket Number:	101044.0001US14
Receipt Date:	22-MAR-2011
Filing Date:	
Time Stamp:	17:44:03
Application Type:	Utility under 35 USC 111(a)

04/01/2011 MNGUYEN 00000009 500341 13069124

01 FC:4011 82.00 DA
02 FC:2111 270.00 DA
03 FC:2311 110.00 DA
04 FC:2202 468.00 DA

Adjustment date: 04/01/2011 MNGUYEN
03/23/2011 INTEFSW 00004582 500341 13069124
01 FC:1011 330.00 CR
02 FC:1111 540.00 CR
03 FC:1311 220.00 CR
04 FC:1202 936.00 CR

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$2026
RAM confirmation Number	4582
Deposit Account	500341
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

PATENT APPLICATION FEE DETERMINATION RECORD
Substitute for Form PTO-875

Application or Docket Number
13/069,124

APPLICATION AS FILED - PART I

FOR	NUMBER FILED (Column 1)	NUMBER EXTRA (Column 2)	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	82		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	270		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	110		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	38 minus 20 =	* 18	x 26 =	468	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =	*	x 110 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $270 ($135 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	930		TOTAL	

APPLICATION AS AMENDED - PART II

AMENDMENT A

	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

AMENDMENT B

	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
13/069,124	03/22/2011		930	101044.0001US14	38	1

CONFIRMATION NO. 9532

FILING RECEIPT

OC000000046931769

24392
FISH & ASSOCIATES, PC
ROBERT D. FISH
2603 Main Street
Suite 1000
Irvine, CA 92614-6232

Date Mailed: 04/08/2011

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Wayne C. Boncyk, Evergreen, CA;
Ronald H. Cohen, Pasadena, CA;

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a DIV of 13/037,317 02/28/2011
which is a DIV of 12/333,630 12/12/2008 PAT 7,899,243
which is a DIV of 10/492,243 05/20/2004 PAT 7,477,780 *
which is a 371 of PCT/US02/35407 11/05/2002
which is a CON of 09/992,942 11/05/2001 PAT 7,016,532
which claims benefit of 60/246,295 11/06/2000
and claims benefit of 60/317,521 09/05/2001
(*)Data provided by applicant is not consistent with PTO records.

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.)

If Required, Foreign Filing License Granted: 04/01/2011

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 13/069,124**

Projected Publication Date: To Be Determined - pending completion of Corrected Papers

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

Image Capture and Identification System and Process

Preliminary Class

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/069,124	03/22/2011	Wayne C. Boncyk	101044.0001US14

CONFIRMATION NO. 9532

FORMALITIES LETTER

OC000000046931770

24392
FISH & ASSOCIATES, PC
ROBERT D. FISH
2603 Main Street
Suite 1000
Irvine, CA 92614-6232

Date Mailed: 04/08/2011

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Filing Date Granted

An application number and filing date have been accorded to this application. The application is informal since it does not comply with the regulations for the reason(s) indicated below. Applicant is given TWO MONTHS from the date of this Notice within which to correct the informalities indicated below. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

The required item(s) identified below must be timely submitted to avoid abandonment:

- A substitute specification in compliance with 37 CFR 1.52, 1.121(b)(3), and 1.125, is required. The substitute specification must be submitted with markings and be accompanied by a clean version (without markings) as set forth in 37 CFR 1.125(c) and a statement that the substitute specification contains no new matter (see 37 CFR 1.125(b)). The specification, claims, and/or abstract page(s) submitted is not acceptable and cannot be scanned or properly stored because:
  - The line spacing on the specification, claims, and/or abstract is not 1½ or double spaced (see 37 CFR 1.52(b)).
  - The specification was submitted in multiple column format and is not suitable for electronic reproduction (see 37 CFR 1.52(a)).
  - The claims and/or abstract contain drawings or flow diagrams on pages **Abstract**. Drawings or flow diagrams are not permitted to be contained in the claims or abstract. See 37 CFR 1.58(a). Drawings and flow diagrams must be submitted separately in accordance with 37 CFR 1.84.

    If the drawings or flow diagrams are contained in the claims, applicant must file:
    (1) an amendment to the claims in compliance with 37 CFR 1.121 (deleting the drawings or flow diagrams); and
    (2) new drawings in compliance with 37 CFR 1.84 and 1.121(d) (if applicant wants to include the drawings or flow diagrams in the application).

    If the drawings or flow diagrams are contained in the abstract, applicant must file:
    (1) a replacement abstract commencing on a separate sheet in compliance with 37 CFR 1.72(b) and 1.121 (deleting the drawings or flow diagrams); and
    (2) new drawings in compliance with 37 CFR 1.84 and 1.121(d) (if applicant wants to include the drawings or flow diagrams in the application).
- Replacement claim(s) commencing on a separate sheet in compliance with 37 CFR 1.75(h) and 1.121 is required. Claims must be consecutively numbered and the same claim number cannot be used for more than one claim. See 37 CFR 1.126.

Applicant is cautioned that correction of the above items may cause the specification and drawings page count to exceed 100 pages. If the specification and drawings exceed 100 pages, applicant will need to submit the required application size fee.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web.
https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at **1-866-217-9197** or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

/mgabre/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Boncyk, Wayne C., et al.

Application No.: 13/069124 Group No.: To be assigned
Filed: 03/22/2011 Examiner: To be assigned
For: Image Capture and Identification System and Process

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

STATEMENT THAT SUBSTITUTE SPECIFICATION CONTAINS NO NEW MATTER (37 C.F.R. § 1.125)

1. Identification of person making this statement

Nicholas J. Witchey
Fish & Associates, PC
2603 Main Street, Suite 1000
Irvine, CA 92614
US

The person making this statement is the attorney in this application, Registration Number 63481.

2. Statement

I hereby state that the accompanying substitute specification contains no new matter over that contained in the above-identified application originally filed.

I further state that the changes made are the same as indicated in the inter-lineated original specification also accompanying this declaration.

/Nicholas J. Witchey/
Nicholas J. Witchey

IMAGE CAPTURE AND IDENTIFICATION SYSTEM AND PROCESS

[0001] This application is a divisional of 13/037317 filed February 28, 2011 which is a divisional of 12/333630 filed December 12, 2008 which is a divisional of 10/492243 filed April 9, 2004 which is a National Phase of PCT/US02/35407 filed November 5, 2002 which is an International Patent application of 09/992942 filed November 5, 2001 which claims priority to provisional application number 60/317521 filed Sept. 5, 2001 and provisional application number 60/246295 filed Nov. 6, 2000. These and all other referenced patents and applications are incorporated herein by reference in their entirety. Where a definition or use of a term in a reference that is incorporated by reference is inconsistent or contrary to the definition of that term provided herein, the definition of that term provided herein is deemed to be controlling.

Technical Field

[0002] The invention relates an identification method and process for objects from digitally captured images thereof that uses image characteristics to identify an object from a plurality of objects in a database.

Background Art

[0003] There is a need to provide hyperlink functionality in known objects without modification to the objects, through reliably detecting and identifying the objects based only on the appearance of the object, and then locating and supplying information pertinent to the object or initiating communications pertinent to the object by supplying an information address, such as a Uniform Resource Locator (URL), pertinent to the object.

[0004] There is a need to determine the position and orientation of known objects based only on imagery of the objects.

[0005] The detection, identification, determination of position and orientation, and subsequent information provision and communication must occur without modification or disfigurement of the object, without the need for any marks, symbols, codes, barcodes, or characters on the object, without the need to touch or disturb the object, without the need for special lighting other than that required for normal human vision, without the need for any communication device (radio frequency, infrared, etc.) to be attached to or nearby the object, and without human assistance in the identification process. The objects to be detected and identified may be 3-dimensional objects, 2-dimensional images (e.g., on paper), or 2-dimensional images of 3-dimensional objects, or human beings.

[0006] There is a need to provide such identification and hyperlink services to persons using mobile computing devices, such as Personal Digital Assistants (PDAs) and cellular telephones.

[0007] There is a need to provide such identification and hyperlink services to machines, such as factory robots and spacecraft.

[0008] Examples include:

[0009] identifying pictures or other art in a museum, where it is desired to provide additional information about such art objects to museum visitors via mobile wireless devices;

[0010] provision of content (information, text, graphics, music, video, etc.), communications, and transaction mechanisms between companies and individuals, via networks (wireless or otherwise) initiated by the individuals "pointing and clicking" with camera-equipped mobile devices on magazine advertisements, posters, billboards, consumer products, music or video disks or tapes, buildings, vehicles, etc.;

[0011] establishment of a communications link with a machine, such a vending machine or information kiosk, by "pointing and clicking" on the machine with a camera-equipped mobile wireless device and then execution of communications or transactions between the mobile wireless device and the machine;

[0012] identification of objects or parts in a factory, such as on an assembly line, by capturing an image of the objects or parts, and then providing information pertinent to the identified objects or parts;

[0013] identification of a part of a machine, such as an aircraft part, by a technician "pointing and clicking" on the part with a camera-equipped mobile wireless device, and then supplying pertinent content to the technician, such maintenance instructions or history for the identified part;

[0014] identification or screening of individual(s) by a security officer "pointing and clicking" a camera-equipped mobile wireless device at the individual(s) and then receiving identification information pertinent to the individuals after the individuals have been identified by face recognition software;

[0015] identification, screening, or validation of documents, such as passports, by a security officer "pointing and clicking" a camera-equipped device at the document and receiving a response from a remote computer;

[0016] determination of the position and orientation of an object in space by a spacecraft nearby the object, based on imagery of the object, so that the spacecraft can maneuver relative to the object or execute a rendezvous with the object;

[0017] identification of objects from aircraft or spacecraft by capturing imagery of the objects and then identifying the objects via image recognition performed on a local or remote computer;

[0018] watching movie previews streamed to a camera-equipped wireless device by "pointing and clicking" with such a device on a movie theatre sign or poster, or on a digital video disc box or videotape box;

[0019] listening to audio recording samples streamed to a camera-equipped wireless device by "pointing and clicking" with such a device on a compact disk (CD) box, videotape box, or print media advertisement;

[0020] purchasing movie, concert, or sporting event tickets by "pointing and clicking" on a theater, advertisement, or other object with a camera-equipped wireless device;

[0021] purchasing an item by "pointing and clicking" on the object with a camera-equipped wireless device and thus initiating a transaction;

[0022] interacting with television programming by "pointing and clicking" at the television screen with a camera-equipped device, thus capturing an image of the screen content and having that image sent to a remote computer and identified, thus initiating interaction based on the screen content received (an example is purchasing an item on the television screen by "pointing and clicking" at the screen when the item is on the screen);

[0023] interacting with a computer-system based game and with other players of the game by "pointing and clicking" on objects in the physical environment that are considered to be part of the game;

[0024] paying a bus fare by "pointing and clicking" with a mobile wireless camera-equipped device, on a fare machine in a bus, and thus establishing a communications link between the device and the fare machine and enabling the fare payment transaction;

[0025] establishment of a communication between a mobile wireless camera-equipped device and a computer with an Internet connection by "pointing and clicking" with the device on the computer and thus providing to the mobile device an Internet address at which it can communicate with the computer, thus establishing communications with the computer despite the absence of a local network or any direct communication between the device and the computer;

[0026] use of a mobile wireless camera-equipped device as a point-of-sale terminal by, for example, "pointing and clicking" on an item to be purchased, thus identifying the item and initiating a transaction.

Disclosure of Invention

[0027] The present invention solves the above stated needs. Once an image is captured digitally, a search of the image determines whether symbolic content is included in the image. If so the symbol is decoded and communication is opened with the proper database, usually using the Internet, wherein the best match for the symbol is returned. In some instances, a symbol may be detected, but non-ambiguous identification is not possible. In that case and when a symbolic image can not be detected, the image is decomposed through identification algorithms where unique characteristics of the image are determined. These characteristics are then used to provide the best match or matches in the data base, the "best" determination being assisted by the partial symbolic information, if that is available.

[0028] Therefore the present invention provides technology and processes that can accommodate linking objects and images to information via a network such as the Internet, which requires no modification to the linked object. Traditional methods for linking objects to digital information, including applying a barcode, radio or optical transceiver or transmitter, or some other means of identification to the object, or modifying the image or object so as to encode detectable information in it, are not required because the image or object can be identified solely by its visual appearance. The users or devices may even interact with objects by "linking" to them. For example, a user may link to a vending machine by "pointing and clicking" on it. His device would be connected over the Internet to the company that owns the vending machine. The company would in turn establish a connection to the vending machine, and thus the user would have a communication channel established with the vending machine and could interact with it.

[0029] The decomposition algorithms of the present invention allow fast and reliable detection and recognition of images and/or objects based on their visual appearance in an image, no matter whether shadows, reflections, partial obscuration, and variations in viewing geometry are present. As stated above, the present invention also can detect, decode, and identify images and objects based on traditional symbols which may appear on the object, such as alphanumeric characters, barcodes, or 2-dimensional matrix codes.

[0030] When a particular object is identified, the position and orientation of an object with respect to the user at the time the image was captured can be determined based on the appearance of the object in an image. This can be the location and/or identity of people scanned by multiple cameras in a security system, a passive locator system more accurate than GPS or usable in areas where GPS signals cannot be received, the location of specific vehicles without requiring a transmission from the vehicle, and many other uses.

[0031] When the present invention is incorporated into a mobile device, such as a portable telephone, the user of the device can link to images and objects in his or her environment by pointing the device at the object of interest, then "pointing and clicking" to capture an image. Thereafter, the device transmits the image to another computer ("Server"), wherein the image is analyzed and the object or image of interest is detected and recognized. Then the network address of information corresponding to that object is transmitted from the ("Server") back to the mobile device, allowing the mobile device to access information using the network address so that only a portion of the information concerning the object need be stored in the systems database.

[0032] Some or all of the image processing, including image/object detection and/or decoding of symbols detected in the image may be distributed arbitrarily between the mobile (Client) device and the Server. In other words, some processing may be performed in the Client device and some in the Server, without specification of which particular processing is performed in each, or all processing may be performed on one platform or the other, or the platforms may be combined so that there is only one platform. The image processing can be implemented in a parallel computing manner, thus facilitating scaling of the system with respect to database size and input traffic loading.

[0033] Therefore, it is an object of the present invention to provide a system and process for identifying digitally captured images without requiring modification to the object.

[0034] Another object is to use digital capture devices in ways never contemplated by their manufacturer.

[0035] Another object is to allow identification of objects from partial views of the object.

[0036] Another object is to provide communication means with operative devices without requiring a public connection therewith.

[0037] These and other objects and advantages of the present invention will become apparent to those skilled in the art after considering the following detailed specification, together with the accompanying drawings wherein:

<u>Brief Description of The Drawings</u>

[0038] FIG. 1 is a schematic block diagram top-level algorithm flowchart;

[0039] FIG. 2 is an idealized view of image capture;

[0040] FIGS. 3A and 3B are a schematic block diagram of process details of the present invention;

[0041] FIG. 4 is a schematic block diagram of a different explanation of invention;

[0042] FIG. 5 is a schematic block diagram similar to FIG. 4 for cellular telephone and personal data assistant (PDA) applications; and

[0043] FIG. 6 is a schematic block diagram for spacecraft applications.

Best Modes for Carrying Out the Invention

[0044] The present invention includes a novel process whereby information such as Internet content is presented to a user, based solely on a remotely acquired image of a physical object. Although coded information can be included in the remotely acquired image, it is not required since no additional information about a physical object, other than its image, needs to be encoded in the linked object. There is no need for any additional code or device, radio, optical or otherwise, to be embedded in or affixed to the object. Image-linked objects can be located and identified within user-acquired imagery solely by means of digital image processing, with the address of pertinent information being returned to the device used to acquire the image and perform the link. This process is robust against digital image noise and corruption (as can result from lossy image compression/decompression), perspective error, rotation, translation, scale differences, illumination variations caused by different lighting sources, and partial obscuration of the target that results from shadowing, reflection or blockage.

[0045] Many different variations on machine vision "target location and identification" exist in the current art. However, they all tend to provide optimal solutions for an arbitrarily restricted search space. At the heart of the present invention is a high-speed image matching engine that returns unambiguous matches to target objects contained in a wide variety of potential input images. This unique approach to image matching takes advantage of the fact that at least some portion of the target object will be found in the user-acquired image. The parallel image comparison processes embodied in the present search technique are, when taken together, unique to the process. Further, additional refinement of the process, with the inclusion of more and/or different decomposition-parameterization functions, utilized within the overall structure of the search loops is not restricted. The detailed process is described in the following. **FIG. 1** shows the overall processing flow and steps. These steps are described in further detail in the following sections.

[0046] For image capture 10, the User 12 (**FIG. 2**) utilizes a computer, mobile telephone, personal digital assistant, or other similar device 14 equipped with an image sensor (such as a CCD or CMOS digital camera). The User 12 aligns the sensor of the image capture device 14 with the object 16 of interest. The linking process is then initiated by suitable means including: the User 12 pressing a button on the device 14 or sensor; by the software in the device 14 automatically recognizing that an image is to be acquired; by User voice command; or by any other appropriate means. The device 14 captures a digital image 18 of the scene at which it is pointed. This image 18 is represented as three separate 2-D matrices of pixels, corresponding to the raw RGB (Red, Green, Blue) representation of the input image. For the purposes of standardizing the analytical processes in this embodiment, if the device 14 supplies an image in other than RGB format, a transformation to RGB is accomplished. These analyses could be carried out in any standard color format, should the need arise.

[0047] If the server 20 is physically separate from the device 14, then user acquired images are transmitted from the device 14 to the Image Processor/Server 20 using a conventional digital network or wireless network means. If the image 18 has been compressed (e.g. via lossy JPEG DCT) in a manner that introduces compression artifacts into the reconstructed image 18, these artifacts may be partially removed by, for example, applying a conventional despeckle filter to the reconstructed image prior to additional processing.

[0048] The Image Type Determination 26 is accomplished with a discriminator algorithm which operates on the input image 18 and determines whether the input image contains recognizable symbols, such as barcodes, matrix codes, or alphanumeric characters. If such symbols are found, the image 18 is sent to the Decode Symbol 28 process. Depending on the confidence level with which the discriminator algorithm finds the symbols, the image 18 also may or alternatively contain an object of interest and may therefore also or alternatively be sent to the Object Image branch of the process flow. For example, if an input image 18 contains both a barcode and an object, depending on the clarity with which the barcode is detected, the image may be analyzed by both the Object Image and Symbolic Image branches, and that branch which has the highest success in identification will be used to identify and link from the object.

[0049] The image is analyzed to determine the location, size, and nature of the symbols in the Decode Symbol 28. The symbols are analyzed according to their type, and their content information is extracted. For example, barcodes and alphanumeric characters will result in numerical and/or text information.

[0050] For object images, the present invention performs a "decomposition", in the Input Image Decomposition 34, of a high-resolution input image into several different types of quantifiable salient parameters. This allows for multiple independent convergent search processes of the database to occur in parallel, which greatly improves image match speed and match robustness in the Database Matching 36. The Best Match 38 from either the Decode Symbol 28, or the image Database Matching 36, or both, is then determined. If a specific URL (or other online address) is associated with the image, then an URL Lookup 40 is performed and the Internet address is returned by the URL Return 42.

[0051] The overall flow of the Input Image Decomposition process is as follows:

```
Radiometric Correction
Segmentation
Segment Group Generation
FOR each segment group
        Bounding Box Generation
        Geometric Normalization
        Wavelet Decomposition
        Color Cube Decomposition
        Shape Decomposition
        Low-Resolution Grayscale Image Generation
FOR END
```

[0052] Each of the above steps is explained in further detail below. For Radiometric Correction, the input image typically is transformed to an 8-bit per color plane, RGB representation. The RGB image is radiometrically normalized in all three channels. This normalization is accomplished by linear gain and offset transformations that result in the pixel values within each color channel spanning a full 8-bit dynamic range (256 possible discrete values). An 8-bit dynamic range is adequate but, of course, as optical capture devices produce higher resolution images and computers get faster and memory gets cheaper, higher bit dynamic ranges, such as 16-bit, 32-bit or more may be used.

[0053] For Segmentation, the radiometrically normalized RGB image is analyzed for "segments," or regions of similar color, i.e. near equal pixel values for red, green, and blue. These segments are defined by their boundaries, which consist of sets of (x, y) point pairs. A map of segment boundaries is produced, which is maintained separately from the RGB input image and is formatted as an x, y binary image map of the same aspect ratio as the RGB image.

[0054] For Segment Group Generation, the segments are grouped into all possible combinations. These groups are known as "segment groups" and represent all possible potential images or objects of interest in the input image. The segment groups are sorted based on the order in which they will be evaluated. Various evaluation order schemes are possible. The particular embodiment explained herein utilizes the following "center-out" scheme: The first segment group comprises only the segment that includes the center of the image. The next segment group comprises the previous segment plus the segment which is the largest (in number of pixels) and which is adjacent to (touching) the previous segment group. Additional segments are added using the segment criteria above until no segments remain. Each step, in which a new segment is added, creates a new and unique segment group.

[0055] For Bounding Box Generation, the elliptical major axis of the segment group under consideration (the major axis of an ellipse just large enough to contain the entire segment group) is computed. Then a rectangle is constructed within the image coordinate system, with long sides parallel to the elliptical major axis, of a size just large enough to completely contain every pixel in the segment group.

[0056] For Geometric Normalization, a copy of the input image is modified such that all pixels not included in the segment group under consideration are set to mid-level gray. The result is then resampled and mapped into a "standard aspect" output test image space such that the corners of the bounding box are mapped into the corners of the output test image. The standard aspect is the same size and aspect ratio as the Reference images used to create the database.

[0057] For Wavelet Decomposition, a grayscale representation of the full-color image is produced from the geometrically normalized image that resulted from the Geometric Normalization step. The following procedure is used to derive the grayscale representation. Reduce the three color planes into one grayscale image by proportionately adding each R, G, and B pixel of the standard corrected color image using the following formula:

$$L_{x,y}=0.34*R_{x,y}+0.55*G_{x,y}+0.44*B_{x,y}$$

[0058] then round to nearest integer value. Truncate at 0 and 255, if necessary. The resulting matrix L is a standard grayscale image. This grayscale representation is at the same spatial resolution as the full color image, with an 8-bit dynamic range. A multi-resolution Wavelet Decomposition of the grayscale image is performed, yielding wavelet coefficients for several scale factors. The Wavelet coefficients at various scales are ranked according to their weight within the image.

[0059] For Color Cube Decomposition, an image segmentation is performed (see "Segmentation" above), on the RGB image that results from Geometric Normalization. Then the RGB image is transformed to a normalized Intensity, In-phase and Quadrature-phase color image (YIQ). The segment map is used to identify the principal color regions of the image, since each segment boundary encloses pixels of similar color. The average Y, I, and Q values of each segment, and their individual component standard deviations, are computed. The following set of parameters result, representing the colors, color variation, and size for each segment:

[0060] Y_{avg}=Average Intensity

[0061] I_{avg}=Average In-phase

[0062] Q_{avg}=Average Quadrature

[0063] Y_{sigma}=Intensity standard deviation

[0064] I_{sigma}=In-phase standard deviation

[0065] Q_{sigma}=Quadrature standard deviation

[0066] N_{pixels}=number of pixels in the segment

[0067] The parameters comprise a representation of the color intensity and variation in each segment. When taken together for all segments in a segment group, these parameters comprise points (or more accurately, regions, if the standard deviations are taken into account) in a three-dimensional color space and describe the intensity and variation of color in the segment group.

[0068] For Shape Decomposition, the map resulting from the segmentation performed in the Color Cube Generation step is used and the segment group is evaluated to extract the group outer edge boundary, the total area enclosed by the boundary, and its area centroid. Additionally, the net ellipticity (semi-major axis divided by semi-minor axis of the closest fit ellipse to the group) is determined.

[0069] For Low-Resolution Grayscale Image Generation, the full-resolution grayscale representation of the image that was derived in the Wavelet Generation step is now subsampled by a factor in both x and y directions. For the example of this embodiment, a 3:1 subsampling is assumed. The subsampled image is produced by weighted averaging of pixels within each 3x3 cell. The result is contrast binned, by reducing the number of discrete values assignable to each pixel based upon substituting a "binned average" value for all pixels that fall within a discrete (TBD) number of brightness bins.

[0070] The above discussion of the particular decomposition methods incorporated into this embodiment are not intended to indicate that more, or alternate, decomposition methods may not also be employed within the context of this invention.

[0071] In other words:

```
FOR each input image segment group
        FOR each database object
                FOR each view of this object
                        FOR each segment group in this view of this database
                        object
                                Shape Comparison
                                Grayscale Comparison
                                Wavelet Comparison
                                Color Cube Comparison
                                Calculate Combined Match Score
                        END FOR
                END FOR
        END FOR
END FOR
```

[0072] Each of the above steps is explained in further detail below.

<u>FOR Each Input Image Segment Group</u>

[0073] This loop considers each combination of segment groups in the input image, in the order in which they were sorted in the "Segment Group Generation" step. Each segment group, as it is considered, is a candidate for the object of interest in the image, and it is compared against database objects using various tests.

[0074] One favored implementation, of many possible, for the order in which the segment groups are considered within this loop is the "center-out" approach mentioned previously in the "Segment Group Generation" section. This scheme considers segment groups in a sequence that represents the addition of adjacent segments to the group, starting at the center of the image. In this scheme, each new group that is considered comprises the previous group plus one additional adjacent image segment. The new group is compared against the database. If the new group results in a higher database matching score than the previous group, then new group is retained. If the new group has a lower matching score then the previous group, then it is discarded and the loop starts again. If a particular segment group results in a match score which is extremely high, then this is considered to be an exact match and no further searching is warranted; in this case the current group and matching database group are selected as the match and this loop is exited.

FOR Each Database Object

[0075] This loop considers each object in the database for comparison against the current input segment group.

FOR Each View of this Object

[0076] This loop considers each view of the current database object, for comparison against the current input segment group. The database contains, for each object, multiple views from different viewing angles.

FOR Each Segment Group in this View of this Database Object

[0077] This loop considers each combination of segment groups in the current view of the database object. These segment groups were created in the same manner as the input image segment groups.

Shape Comparison

Inputs:

[0078] For the input image and all database images:

[0079] I. Segment group outline

[0080] II. Segment group area

[0081] III. Segment group centroid location

[0082] IV. Segment group bounding ellipse ellipticity

Algorithm:

[0083] V. Identify those database segment groups with an area approximately equal to that of the input segment group, within TBD limits, and calculate an area matching score for each of these "matches."

[0084] VI. Within the set of matches identified in the previous step, identify those database segment groups with an ellipticity approximately equal to that of the input segment group, within TBD limits, and calculate an ellipticity position matching score for each of these "matches."

[0085] Within the set of matches identified in the previous step, identify those database segment groups with a centroid position approximately equal to that of the input segment group, within TBD limits, and calculate a centroid position matching score for each of these "matches."

[0086] VIII. Within the set of matches identified in the previous step, identify those database segment groups with an outline shape approximately equal to that of the input segment group, within TBD limits, and calculate an outline matching score for each of these "matches." This is done by comparing the two outlines and analytically determining the extent to which they match.

[0087] Note: this algorithm need not necessarily be performed in the order of Steps 1 to 4. It could alternatively proceed as follows:

```
FOR each database segment group
    IF the group passes Step 1
        IF the group passes Step 2
            IF the group passes Step 3
                IF the group passes Step 4
                    Successful comparison, save result
                END IF
            END IF
        END IF
    END IF
END FOR
```

__Grayscale Comparison__

__Inputs:__

[0088] For the input image and all database images:

[0089] IX. Low-resolution, normalized, contrast-binned, grayscale image of pixels within segment group bounding box, with pixels outside of the segment group set to a standard background color.

Algorithm:

[0090] Given a series of concentric rectangular "tiers" of pixels within the low-resolution images, compare the input image pixel values to those of all database images. Calculate a matching score for each comparison and identify those database images with matching scores within TBD limits, as follows:

```
FOR each database image
    FOR each tier, starting with the innermost and progressing to the outermost
        Compare the pixel values between the input and database image
        Calculate an aggregate matching score
        IF matching score is greater than some TBD limit (i.e., close match)
            Successful comparison, save result
        END IF
    END FOR
END FOR
```

Wavelet Comparison

Inputs:

[0091] For the input image and all database images:

[0092] X. Wavelet coefficients from high-resolution grayscale image within segment group bounding box.

Algorithm:

[0093] Successively compare the wavelet coefficients of the input segment group image and each database segment group image, starting with the lowest-order coefficients and progressing to the highest order coefficients. For each comparison, compute a matching score. For each new coefficient, only consider those database groups that had matching scores, at the previous (next lower order) coefficient within TBD limits.

```
FOR each database image
    IF input image C0 equals database image C0 within TBD limit
        IF input image C1 equals database image C1 within TBD limit
            IF input image CN equals database image CN within TBD
            limit
                Close match, save result and match score
            END IF
        END IF
    END IF
END FOR
```

Notes:
I. "C_i" are the wavelet coefficients, with C_0 being the lowest order coefficient and C_N being the highest.
II. When the coefficients are compared, they are actually compared on a statistical (e.g. Gaussian) basis, rather than an arithmetic difference.
III. Data indexing techniques are used to allow direct fast access to database images according to their C_i values. This allows the algorithm to successively narrow the portions of the database of interest as it proceeds from the lowest order terms to the highest.

Color Cube Comparison

Inputs:

[0094] [Y_{avg}, I_{avg}, Q_{avg}, Ys_{igma}, I_{sigma}, Q_{sigma}, N_{pixels}] data sets ("Color Cube Points") for each segment in:

[0095] I. The input segment group image

[0096] II. Each database segment group image

Algorithm:

```
FOR each database image
    FOR each segment group in the database image
        FOR each Color Cube Point in database segment group, in order of
        descending N_pixels value
            IF Gaussian match between input (Y,I,Q) and database
            (Y,I,Q)
            I. Calculate match score for this segment
            II. Accumulate segment match score into aggregate match
            score for segment group
            III. IF aggregate matching score is greater than some TBD
            limit (i.e., close match)
                Successful comparison, save result
            END IF
        END FOR
    END FOR
END FOR
```

Notes:
I. The size of the Gaussian envelope about any Y, I, Q point is determined by RSS of standard deviations of Y, I, and Q for that point.

Calculate Combined Match Score

[0097] The four Object Image comparisons (Shape Comparison, Grayscale Comparison, Wavelet Comparison, Color Cube Comparison) each return a normalized matching score. These are independent assessments of the match of salient features of the input image to database images. To minimize the effect of uncertainties in any single comparison process, and to thus minimize the likelihood of returning a false match, the following root sum of squares relationship is used to combine the results of the individual comparisons into a combined match score for an image:

$$\text{CurrentMatch}=\text{SQRT}(W_{OC}M_{OC}^2+W_{CCC}M_{CCC}^2+W_{WC}M_{WC}^2+W_{SGC}M_{SGC}^2)$$

where Ws are TBD parameter weighting coefficients and Ms are the individual match scores of the four different comparisons.

[0098] The unique database search methodology and subsequent object match scoring criteria are novel aspects of the present invention that deserve special attention. Each decomposition of the Reference image and Input image regions represent an independent characterization of salient characteristics of the image. The Wavelet Decomposition, Color Cube Decomposition, Shape Decomposition, and evaluation of a sub-sampled low-resolution Grayscale representation of an input image all produce sets of parameters that describe the image in independent ways. Once all four of these processes are completed on the image to be tested, the parameters provided by each characterization are compared to the results of identical characterizations of the Reference images, which have been previously calculated and stored in the database. These comparisons, or searches, are carried out in parallel. The result of each search is a numerical score that is a weighted measure of the number of salient characteristics that "match" (i.e. that are statistically equivalent). Near equivalencies are also noted, and are counted in the cumulative score, but at a significantly reduced weighting.

[0099] One novel aspect of the database search methodology in the present invention is that not only are these independent searches carried out in parallel, but also, all but the low-resolution grayscale compares are "convergent." By convergent, it is meant that input image parameters are searched sequentially over increasingly smaller subsets of the entire database. The parameter carrying greatest weight from the input image is compared first to find statistical matches and near-matches in all database records. A normalized interim score (e.g., scaled value from zero to one, where one is perfect match and zero is no match) is computed, based on the results of this comparison. The next heaviest weighted parameter from the input image characterization is then searched on only those database records having initial interim scores above a minimum acceptable threshold value. This results in an incremental score that is incorporated into the interim score in a cumulative fashion. Then, subsequent compares of increasingly lesser-weighted parameters are assessed only on those database records that have cumulative interim scores above the same minimum acceptable threshold value in the previous accumulated set of tests.

[00100] This search technique results in quick completion of robust matches, and establishes limits on the domain of database elements that will be compared in a subsequent combined match calculation and therefore speeds up the process. The convergent nature of the search in these comparisons yields a ranked subset of the entire database.

[00101] The result of each of these database comparisons is a ranking of the match quality of each image, as a function of decomposition search technique. Only those images with final cumulative scores above the acceptable match threshold will be assessed in the next step, a Combined Match Score evaluation.

[00102] Four database comparison processes, Shape Comparison, Grayscale Comparison, Wavelet Comparison, and Color Cube Comparison, are performed. These processes may occur sequentially, but generally are preferably performed in parallel on a parallel computing platform. Each comparison technique searches the entire image database and returns those images that provide the best matches, for the particular algorithm, along with the matching scores for these images. These comparison algorithms are performed on segment groups, with each input image segment group being compared to each segment group for each database image.

[00103] **FIGS. 3A** and **3B** show the process flow within the Database Matching operation. The algorithm is presented here as containing four nested loops with four parallel processes inside the innermost loop. This structure is for presentation and explanation only. The actual implementation, although performing the same operations at the innermost layer, can have a different structure in order to achieve the maximum benefit from processing speed enhancement techniques such as parallel computing and data indexing techniques. It is also important to note that the loop structures can be implemented independently for each inner comparison, rather than the shared approach shown in the FIGS. 3A and 3B.

[00104] Preferably, parallel processing is used to divide tasks between multiple CPUs (Central Processing Units) and/or computers. The overall algorithm may be divided in several ways, such as:

Sharing the Outer Loop:	In this technique, all CPUs run the entire algorithm, including the outer loop, but one CPU runs the loop for the first N cycles, another CPU for the second N cycles, all simultaneously.
Sharing the Comparisons:	In this technique, one CPU performs the loop functions. When the comparisons are performed, they are each passed to a separate CPU to be performed in parallel.
Sharing the Database:	This technique entails splitting database searches between CPUs, so that each CPU is responsible for searching one section of the database, and the sections are searched in parallel by multiple CPUs. This is, in essence, a form of the "Sharing the Outer Loop" technique described above.

[00105] Actual implementations can be some combination of the above techniques that optimizes the process on the available hardware.

[00106] Another technique employed to maximize speed is data indexing. This technique involves using a priori knowledge of where data resides to only search in those parts of the database that contain potential matches. Various forms of indexing may be used, such as hash tables, data compartmentalization (i.e., data within certain value ranges are stored in certain locations), data sorting, and database table indexing. An example of such techniques is, in the Shape Comparison algorithm (see below), if a database is to be searched for an entry with an Area with a value of A, the algorithm would know which database entries or data areas have this approximate value and would not need to search the entire database.

[00107] Another technique employed is as follows. **FIG. 4** shows a simplified configuration of the invention. Boxes with solid lines represent processes, software, physical objects, or devices. Boxes with dashed lines represent information. The process begins with an object of interest: the target object 100. In the case of consumer applications, the target object 100 could be, for example, beverage can, a music CD box, a DVD video box, a magazine advertisement, a poster, a theatre, a store, a building, a car, or any other object that user is interested in or wishes to interact with. In security applications the target object 100 could be, for example, a person, passport, or driver's license, etc. In industrial applications the target object 100 could be, for example, a part in a machine, a part on an assembly line, a box in a warehouse, or a spacecraft in orbit, etc.

[00108] The terminal 102 is a computing device that has an "image" capture device such as digital camera 103, a video camera, or any other device that an convert a physical object into a digital representation of the object. The imagery can be a single image, a series of images, or a continuous video stream. For simplicity of explanation this document describes the digital imagery generally in terms of a single image, however the invention and this system can use all of the imagery types described above.

[00109] After the camera 103 captures the digital imagery of the target object 100, image preprocessing 104 software converts the digital imagery into image data 105 for transmission to and analysis by an identification server 106. Typically a network connection is provided capable of providing communications with the identification server 106. Image data 105 is data extracted or converted from the original imagery of the target object 100 and has information content appropriate for identification of the target object 100 by the object recognition 107, which may be software or hardware. Image data 105 can take many forms, depending on the particular embodiment of the invention. Examples of image data 105 are:

[00110] Compressed (e.g., JPEG2000) form of the raw imagery from camera 103;

[00111] Key image information, such as spectral and/or spatial frequency components (e.g. wavelet components) of the raw imagery from camera 103; and

[00112] MPEG video stream created from the raw imagery from camera 103.

[00113] The particular form of the image data 105 and the particular operations performed in image preprocessing 104 depend on:

[00114] Algorithm and software used in object recognition 107 Processing power of terminal 102;

[00115] Network connection speed between terminal 102 and identification server 106;

[00116] Application of the System; and

[00117] Required system response time.

[00118] In general, there is a tradeoff between the network connection speed (between terminal 102 and identification server 106) and the processing power of terminal 102. The results all of the above tradeoffs will define the nature of image preprocessing 104 and image data 105 for a specific embodiment. For example, image preprocessing 104 could be image compression and image data 105 compressed imagery, or image preprocessing 104 could be wavelet analysis and image data 105 could be wavelet coefficients.

[00119] The image data 105 is sent from the terminal 102 to the identification server 106. The identification server 106 receives the image data 105 and passes it to the object recognition 107.

[00120] The identification server 106 is a set of functions that usually will exist on computing platform separate from the terminal 102, but could exist on the same computing platform. If the identification server 106 exists on a separate computing device, such as a computer in a data center, then the transmission of the image components 105 to the identification server 106 is accomplished via a network or combination of networks, such a cellular telephone network, wireless Internet, Internet, and wire line network. If the identification server 106 exists on the same computing device as the terminal 102 then the transmission consists simply of a transfer of data from one software component or process to another.

[00121] Placing the identification server 106 on a computing platform separate from the terminal 102 enables the use of powerful computing resources for the object recognition 107 and database 108 functions, thus providing the power of these computing resources to the terminal 102 via network connection. For example, an embodiment that identifies objects out of a database of millions of known objects would be facilitated by the large storage, memory capacity, and processing power available in a data center; it may not be feasible to have such computing power and storage in a mobile device. Whether the terminal 102 and the identification server 106 are on the same computing platform or separate ones is an architectural decision that depends on system response time, number of database records, image recognition algorithm computing power and storage available in terminal 102, etc., and this decision must be made for

each embodiment of the invention. Based on current technology, in most embodiments these functions will be on separate computing platforms.

[00122] The overall function of the identification server 106 is to determine and provide the target object information 109 corresponding to the target object 100, based on the image data 105.

[00123] The object recognition 107 and the database 108 function together to:

[00124] 1. Detect, recognize, and decode symbols, such as barcodes or text, in the image.

[00125] 2. Recognize the object (the target object 100) in the image.

[00126] 3. Provide the target object information 109 that corresponds to the target object 100. The target object information 109 usually (depending on the embodiment) includes an information address corresponding to the target object 100.

[00127] The object recognition 107 detects and decodes symbols, such as barcodes or text, in the input image. This is accomplished via algorithms, software, and/or hardware components suited for this task. Such components are commercially available (The HALCON software package from MVTec is an example). The object recognition 107 also detects and recognizes images of the target object 100 or portions thereof. This is accomplished by analyzing the image data 105 and comparing the results to other data, representing images of a plurality of known objects, stored in the database 108, and recognizing the target object 100 if a representation of target object 100 is stored in the database 108.

[00128] In some embodiments the terminal 102 includes software, such as a web browser (the browser 110), that receives an information address, connects to that information address via a network or networks, such as the Internet, and exchanges information with another computing device at that information address. In consumer applications the terminal 102 may be a portable cellular telephone or Personal Digital Assistant equipped with a camera 103 and wireless Internet connection. In security and industrial applications the terminal 102 may be a similar portable hand-held device or may be fixed in location and/or orientation, and may have either a wireless or wire line network connection.

[00129] Other object recognition techniques also exist and include methods that store 3-dimensional models (rather than 2-dimensional images) of objects in a database and correlate input images with these models of the target object is performed by an object recognition technique of which many are available commercially and in the prior art. Such object recognition techniques usually consist of comparing a new input image to a plurality of known images and detecting correspondences between the new input image and one of more of the known images. The known images are views of known objects from a plurality of viewing angles and thus allow recognition of 2-dimensional and 3-dimensional objects in arbitrary orientations relative to the camera 103.

[00130] FIG. 4 shows the object recognition 107 and the database 108 as separate functions for simplicity. However, in many embodiments the object recognition 107 and the database 108 are so closely interdependent that they may be considered a single process.

[00131] There are various options for the object recognition technique and the particular processes performed within the object recognition 107 and the database 108 depend on this choice. The choice depends on the nature, requirements, and architecture of the particular embodiment of the invention. However, most embodiments will usually share most of the following desired attributes of the image recognition technique:

[00132] Capable of recognizing both 2-dimensional (i.e., flat) and 3-dimensional objects;

[00133] Capable of discriminating the target object 100 from any foreground or background objects or image information, i.e., be robust with respect to changes in background;

[00134] Fast;

[00135] Autonomous (no human assistance required in the recognition process);

[00136] Scalable; able to identify objects from a large database of known objects with short response time; and

[00137] Robust with respect to:

[00138] Affine transformations (rotation, translation, scaling);

[00139] Non-affine transformations (stretching, bending, breaking);

[00140] Occlusions (of the target object 100);

[00141] Shadows (on the target object 100);

[00142] Reflections (on the target object 100);

[00143] Variations in light color temperature;

[00144] Image noise;

[00145] Capable of determining position and orientation of the target object 100 in the original imagery; and

[00146] Capable of recognizing individual human faces from a database containing data representing a large plurality of human faces.

[00147] All of these attributes do not apply to all embodiments. For example, consumer linking embodiments generally do not require determination of position and orientation of the target object 100, while a spacecraft target position and orientation determination system generally would not be required to identify human faces or a large number of different objects.

[00148] It is usually desirable that the database 108 be scalable to enable identification of the target object 100 from a very large plurality (for example, millions) of known objects in the database 108. The algorithms, software, and computing hardware must be designed to function together to quickly perform such a search. An example software technique for performing such searching quickly is to use a metric distance comparison technique for comparing the image data 105 to data stored in the database 108, along with database clustering and multiresolution distance comparisons. This technique is described in "Fast Exhaustive Multi-Resolution Search Algorithm Based on Clustering for Efficient Image Retrieval," by Song, Kim, and Ra, 2000.

[00149] In addition to such software techniques, a parallel processing computing architecture may be employed to achieve fast searching of large databases. Parallel processing is particularly important in cases where a non-metric distance is used in object recognition 107, because techniques such database clustering and multiresolution search may not be possible and thus the complete database must be searched by partitioning the database across multiple CPUs.

[00150] As described above, the object recognition 107 can also detect identifying marks on the target object 100. For example, the target object 100 may include an identifying number or a barcode. This information can be decoded and used to identify or help identify the target object 100 in the database 108. This information also can be passed on as part of the target object information 109. If the information is included as part of the target object information 109 then it can be used by the terminal 102 or content server 111 to identify the specific target object 100, out of many such objects that have similar appearance and differ only in the identifying marks. This technique is useful, for example, in cases where the target object 100 is an active device with a network connection (such as a vending machine) and the content server establishes communication with the target object 100. A combination with a Global Positioning System can also be used to identify like objects by their location.

[00151] The object recognition 107 may be implemented in hardware, software, or a combination of both. Examples of each category are presented below.

[00152] Hardware object recognition implementations include optical correlators, optimized computing platforms, and custom hardware.

[00153] Optical correlators detect objects in images very rapidly by, in effect, performing image correlation calculations with light. Examples of optical correlators are:

[00154] Litton Miniaturized Ruggedized Optical Correlator, from Northrop Grumman Corp;

[00155] Hybrid Digital/Optical Correlator, from the School of Engineering and Information Technology, University of Sussex, UK; and

[00156] OC-VGA3000 and OC-VGA6000 Optical Correlators from INO, Quebec, Canada.

[00157] Optimized computing platforms are hardware computing systems, usually on a single board, that are optimized to perform image processing and recognition algorithms very quickly. These platforms must be programmed with the object recognition algorithm of choice. Examples of optimized computing platforms are:

[00158] VIP/Balboa™ Image Processing Board, from Irvine Sensors Corp.; and

[00159] 3DANN™-R Processing System, from Irvine Sensors Corp.

[00160] Image recognition calculations can also be implemented directly in custom hardware in forms such as Application Specific Integrated Circuits (ASICs), Field Programmable Gate Arrays (FPGAs), and Digital Signal Processors (DSPs).

[00161] There are many object and image recognition software applications available commercially and many algorithms published in the literature. Examples of commercially available image/object recognition software packages include:

[00162] Object recognition system, from Sandia National Laboratories;

[00163] Object recognition perception modules, from Evolution Robotics;

[00164] ImageFinder, from Attrasoft;

[00165] ImageWare, from Roz Software Systems; and

[00166] ID-2000, from Imagis Technologies.

[00167] Some of the above recognition systems include 3-dimensional object recognition capability while others perform 2-dimensional image recognition. The latter type are used to perform 3-dimensional object recognition by comparing input images to a plurality of 2-dimensional views of objects from a plurality of viewing angles.

[00168] Examples of object recognition algorithms in the literature and intended for implementation in software are:

[00169] Distortion Invariant Object Recognition in the Dynamic Link Architecture, Lades et al, 1993;

[00170] SEEMORE: Combining Color, Shape, and Texture Histogramming in a Neurally Inspired Approach to Visual Object Recognition, Mel, 1996;

[00171] Probabilistic Affine Invariants for Recognition, Leung et al, 1998;

[00172] Software Library for Appearance Matching (SLAM), Nene at al, 1994;

[00173] Probabilistic Models of Appearance for 3-D Object Recognition, Pope & Lowe, 2000;

[00174] Matching 3D Models with Shape Distributions, Osada et al, 2001;

[00175] Finding Pictures of Objects in Large Collections of Images, Forsyth et al, 1996;

[00176] The Earth Mover's Distance under Transformation Sets, Cohen & Guibas, 1999;

[00177] Object Recognition from Local Scale-Invariant Features, Lowe, 1999; and

[00178] Fast Object Recognition in Noisy Images Using Simulated Annealing, Betke & Makris, 1994.

[00179] Part of the current invention is the following object recognition algorithm specifically designed to be used as the object recognition 107 and, to some extent, the database 108. This algorithm is robust with respect to occlusions, reflections, shadows, background/foreground clutter, object deformation and breaking, and is scalable to large databases. The task of the algorithm is to find an object or portion thereof in an input image, given a database of multiple objects with multiple views (from different angles) of each object.

[00180] This algorithm uses the concept of a Local Image Descriptor (LID) to summarize the information in a local region of an image. A LID is a circular subset, or "cutout," of a portion of an image. There are various formulations for LIDs; two examples are:

[00181] LID Formulation 1

[00182] The area within the LID is divided into range and angle bins. The average color in each [range,angle] bin is calculated from the pixel values therein.

[00183] LID Formulation 2

[00184] The area within the LID is divided into range bins. The color histogram values within each range bin are calculated from the pixel values therein. For each range bin, a measure of the

variation of color with angle is calculated as, for example, the sum of the changes in average color between adjacent small angular slices of a range bin.

[00185] A LID in the input image is compared to a LID in a database image by a comparison technique such the L1 Distance, L2 Distance, Unfolded Distance, Earth Mover Distance, or cross-correlation. Small distances indicate a good match between the portions of the images underlying the LIDS. By iteratively changing the position and size of the LIDs in the input and database images the algorithm converges on the best match between circular regions in the 2 images.

[00186] Limiting the comparisons to subsets (circular LIDs) of the images enables the algorithm to discriminate an object from the background. Only LIDs that fall on the object, as opposed to the background, yield good matches with database images. This technique also enable matching of partially occluded objects; a LID that falls on the visible part of an occluded object will match to a LID in the corresponding location in the database image of the object.

[00187] The iteration technique used to find the best match is simulated annealing, although genetic search, steepest descent, or other similar techniques appropriate for multivariable optimization can also be used individually or in combination with simulated annealing. Simulated annealing is modeled after the concept of a molten substance cooling and solidifying into a solid. The algorithm starts at a given temperature and then the temperature is gradually reduced with time. At each time step, the values of the search variables are perturbed from the their previous values to a create a new "child" generation of LIDs. The perturbations are calculated statistically and their magnitudes are functions of the temperature. As the temperature decreases the perturbations decrease in size. The child LIDs, in the input and database images, are then compared. If the match is better than that obtained with the previous "parent" generation, then a statistical decision is made regarding to whether to accept or reject the child LIDs as the current best match. This is a statistical decision that is a function of both the match distance and the temperature. The probability of child acceptance increases with temperature and decreases with match distance. Thus, good matches (small match distance) are more likely to be accepted but poor matches can also be accepted occasionally. The latter case is more likely to occur early in the process when the temperature is high. Statistical acceptance of poor matches is included to allow the algorithm to "jump" out of local minima.

[00188] When LID Formulation 1 is used, the rotation angle of the LID need not necessarily be a simulated annealing search parameter. Faster convergence can be obtained by performing a simple step-wise search on rotation to find the best orientation (within the tolerance of the step size) within each simulated annealing time step.

[00189] The search variables, in both the input and database images, are:

[00190] LID x-position;

[00191] LID y-position;

[00192] LID radius;

[00193] LID x-stretch;

[00194] LID y-stretch; and

[00195] LID orientation angle (only for LID Formulation 1).

[00196] LID x-stretch and LID y-stretch are measures of "stretch" distortion applied to the LID circle, and measure the distortion of the circle into an oval. This is included to provide robustness to differences in orientation and curvature between the input and database images.

[00197] The use of multiple simultaneous LIDs provides additional robustness to occlusions, shadows, reflections, rotations, deformations, and object breaking. The best matches for multiple input image LIDS are sought throughout the database images. The input image LIDS are restricted to remain at certain minimum separation distances from each other. The minimum distance between any 2 LIDs centers is a function of the LID radii. The input image LIDS converge and settle on the regions of the input image having the best correspondence to any regions of any database images. Thus the LIDs behave in the manner of marbles rolling towards the lowest spot on a surface, e.g., the bottom of a bowl, but being held apart by their radius (although LIDS generally have minimum separation distances that are less than their radii).

[00198] In cases where the object in the input image appears deformed or curved relative to the known configuration in which it appears in the database, multiple input image LIDS will match to different database images. Each input image LID will match to that database image which shows the underlying portion of the object as it most closely resembles the input image. If the input image object is bent, e.g., a curved poster, then one part will match to one database orientation and another part will match to a different orientation.

[00199] In the case where the input image object appears to be broken into multiple pieces, either due to occlusion or to physical breakage, use of multiple LIDs again provides robust matching: individual LIDs "settle" on portions of the input image object as they match to corresponding portions of the object in various views in the database.

[00200] Robustness with respect to shadows and reflections is provided by LIDs simply not detecting good matches on these input image regions. They are in effect accommodated in the same manner as occlusions.

[00201] Robustness with respect to curvature and bending is accommodated by multiple techniques. First, use of multiple LIDs provides such robustness as described above. Secondly, curvature and bending robustness is inherently provided to some extent within each LID by use of LID range bin sizes that increase with distance from the LID center (e.g., logarithmic spacing). Given matching points in an input image and database image, deformation of the input image object away from the plane tangent at the matching point increases with distance from the matching point. The larger bin sizes of the outer bins (in both range and angle) reduce this sensitivity because they are less sensitive to image shifts.

[00202] Robustness with respect to lighting color temperature variations is provided by normalization of each color channel within each LID.

[00203] Fast performance, particular with large databases, can be obtained through several techniques, as follows:

[00204] 1. Use of LID Formulation 2 can reduce the amount of search by virtue of being rotationally invariant, although this comes at the cost of some robustness due to loss of image information.

[00205] 2. If a metric distance (e.g., L1, L2, or Unfolded) is used for LID comparison, then database clustering, based on the triangle inequality, can be used to rule out large portions of the database from searching. Since database LIDs are created during the execution of the algorithm, the run-time database LIDs are not clustered. Rather, during preparation of the database, sample LIDs are created from the database images by sampling the search parameters throughout their valid ranges. From this data, bounding clusters can be created for each image and for portions of images. With this information the search algorithm can rule out portions of the search parameter space.

[00206] 3. If a metric distance is used, then progressive multiresolution search can be used. This technique saves time by comparing data first at low resolution and only proceeds with successive higher-resolution comparison on candidates with correlations better than the current best match. A discussion of this technique, along with database clustering, can be found in "Fast Exhaustive Multi-Resolution Search Algorithm Based on Clustering for Efficient Image Retrieval," by Song et al, 2000.

[00207] 4. The parameter search space and number of LIDs can be limited. Bounds can be placed, for example, on the sizes of LIDs depending on the expected sizes of input image objects relative to those in the database. A small number of LIDs, even 1, can be used, at the expense of some robustness.

[00208] 5. LIDs can be fixed in the database images. This eliminates iterative searching on database LID parameters, at the expense of some robustness.

[00209] 6. The "x-stretch" and "y-stretch" search parameters can be eliminated, although there is a trade-off between these search parameters and the number of database images. These parameters increase the ability to match between images of the same object in different orientations. Elimination of these parameters may require more database images with closer angular spacing, depending on the particular embodiment.

[00210] 7. Parallel processing can be utilized to increase computing power.

[00211] This technique is similar to that described by Betke & Makris in "Fast Object Recognition in Noisy Images Using Simulated Annealing", 1994, with the following important distinctions:

[00212] The current algorithm is robust with respect to occlusion. This is made possible by varying size and position of LIDs in database images, during the search process, in order to match non-occluded portions of database images.

[00213] The current algorithm can identify 3-dimensional objects by containing views of objects from many orientations in the database.

[00214] The current algorithm uses database clustering to enable rapid searching of large databases.

[00215] The current algorithm uses circular LIDs.

[00216] In addition to containing image information, the database 108 also contains address information. After the target object 100 has been identified, the database 108 is searched to find information corresponding to the target object 100. This information can be an information address, such as an Internet URL. The identification server 106 then sends this information, in the form of the target object information 109, to the terminal 102. Depending on the particular embodiment of the invention, the target object information 109 may include, but not be limited to, one or more of the following items of information pertaining to the target object 100:

[00217] Information address (e.g., Internet URL);

[00218] Identity (e.g., object name, number, classification, etc.);

[00219] Position;

[00220] Orientation;

[00221] Size;

[00222] Color;

[00223] Status;

[00224] Information decoded from and/or referenced by symbols (e.g. information coded in a barcode or a URL referenced by such a barcode); and

[00225] Other data (e.g. alphanumerical text).

[00226] Thus, the identification server determines the identity and/or various attributes of the target object 100 from the image data 105.

[00227] The target object information 109 is sent to the terminal 102. This information usually flows via the same communication path used to send the image data 105 from the terminal 102 to the identification server 106, but this is not necessarily the case. This method of this flow information depends on the particular embodiment of the invention.

[00228] The terminal 102 receives the target object information 109. The terminal 102 then performs some action or actions based on the target object information 109. This action or actions may include, but not be limited to:

[00229] Accessing a web site.

[00230] Accessing or initiating a software process on the terminal 102.

[00231] Accessing or initiating a software process on another computer via a network or networks such as the Internet.

[00232] Accessing a web service (a software service accessed via the Internet).

[00233] Initiating a telephone call (if the terminal 102 includes such capability) to a telephone number that may be included in or determined by the target object Information, may be stored in the terminal 102, or may be entered by the user.

[00234] Initiating a radio communication (if the terminal 102 includes such capability) using a radio frequency that may be included in or determined by the target object Information, may be stored in the terminal 102, or may be entered by the user.

[00235] Sending information that is included in the target object information 109 to a web site, a software process (on another computer or on the terminal 102), or a hardware component.

[00236] Displaying information, via the screen or other visual indication, such as text, graphics, animations, video, or indicator lights.

[00237] Producing an audio signal or sound, including playing music.

[00238] In many embodiments, the terminal 102 sends the target object information 109 to the browser 110. The browser 110 may or may not exist in the terminal 102, depending on the particular embodiment of the invention. The browser 110 is a software component, hardware component, or both, that is capable of communicating with and accessing information from a computer at an information address contained in target object information 109.

[00239] In most embodiments the browser 110 will be a web browser, embedded in the terminal 102, capable of accessing and communicating with web sites via a network or networks such as the Internet. In some embodiments, however, such as those that only involve displaying the identity, position, orientation, or status of the target object 100, the browser 110 may be a software component or application that displays or provides the target object information 109 to a human user or to another software component or application.

[00240] In embodiments wherein the browser 110 is a web browser, the browser 110 connects to the content server 111 located at the information address (typically an Internet URL) included in the target object information 109. This connection is effected by the terminal 102 and the browser 110 acting in concert. The content server 111 is an information server and computing system. The connection and information exchanged between the terminal 102 and the content server 111 generally is accomplished via standard Internet and wireless network software, protocols (e.g. HTTP, WAP, etc.), and networks, although any information exchange technique can be used. The physical network connection depends on the system architecture of the particular embodiment but in most embodiments will involve a wireless network and the Internet. This physical network will most likely be the same network used to connect the terminal 102 and the identification server 106.

[00241] The content server 111 sends content information to the terminal 102 and browser 110. This content information usually is pertinent to the target object 100 and can be text, audio, video, graphics, or information in any form that is usable by the browser 110 and terminal 102. The terminal 102 and browser 110 send, in some embodiments, additional information to the content server 111. This additional information can be information such as the identity of the user of the terminal 102 or the location of the user of the terminal 102 (as determined from a GPS system or a radio-frequency ranging system). In some embodiments such information is provided to the content server by the wireless network carrier.

[00242] The user can perform ongoing interactions with the content server 111. For example, depending on the embodiment of the invention and the applications, the user can:

[00243] Listen to streaming audio samples if the target object 100 is an audio recording (e.g., compact audio disc).

[00244] Purchase the target object 100 via on-line transaction, with the purchase amount billed to an account linked to the terminal 102, to the individual user, to a bank account, or to a credit card.

[00245] In some embodiments the content server 111 may reside within the terminal 102. In such embodiments, the communication between the terminal 102 and the content server 111 does not occur via a network but rather occurs within the terminal 102.

[00246] In embodiments wherein the target object 100 includes or is a device capable of communicating with other devices or computers via a network or networks such as the Internet, and wherein the target object information 109 includes adequate identification (such as a sign, number, or barcode) of the specific target object 100, the content server 111 connects to and exchanges information with the target object 100 via a network or networks such as the Internet. In this type of embodiment, the terminal 102 is connected to the content server 111 and the content server 111 is connected to the target object 100. Thus, the terminal 102 and target object 100 can communicate via the content server 111. This enables the user to interact with the target object 100 despite the lack of a direct connection between the target object 100 and the terminal 102.

[00247] The following are examples of embodiments of the invention.

[00248] **FIG. 5** shows a preferred embodiment of the invention that uses a cellular telephone, PDA, or such mobile device equipped with computational capability, a digital camera, and a wireless network connection, as the terminal 202 corresponding to the terminal 102 in FIG. 4. In this embodiment, the terminal 202 communicates with the identification server 206 and the content server 211 via networks such as a cellular telephone network and the Internet.

[00249] This embodiment can be used for applications such as the following ("User" refers to the person operating the terminal 202, and the terminal 202 is a cellular telephone, PDA, or similar device, and "point and click" refers to the operation of the User capturing imagery of the target object 200 and initiating the transfer of the image data 205 to the identification server 206).

[00250] The User "points and clicks" the terminal 202 at a compact disc (CD) containing recorded music or a digital video disc (DVD) containing recorded video. The terminal 202 browser connects to the URL corresponding to the CD or DVD and displays a menu of options from which the user can select. From this menu, the user can listen to streaming audio samples of the CD or streaming video samples of the DVD, or can purchase the CD or DVD.

[00251] The User "points and clicks" the terminal 202 at a print media advertisement, poster, or billboard advertising a movie, music recording, video, or other entertainment. The browser 210 connects to the URL corresponding to the advertised item and the user can listen to streaming audio samples, purchase streaming video samples, obtain show times, or purchase the item or tickets.

[00252] The User "points and clicks" the terminal 202 at a television screen to interact with television programming in real-time. For example, the programming could consist of a product promotion involving a reduced price during a limited time. Users that "point and click" on this television programming during the promotion are linked to a web site at which they can purchase the product at the promotional price. Another example is a interactive television programming in which users "point and click" on the television screen at specific times, based on the on-screen content, to register votes, indicate actions, or connect to a web site through which they perform real time interactions with the on-screen program.

[00253] The User "points and clicks" on an object such as a consumer product, an advertisement for a product, a poster, etc., the terminal 202 makes a telephone call to the company selling the product, and the consumer has a direct discussion with a company representative regarding the company's product or service. In this case the company telephone number is included in the target object information 209. If the target object information 209 also includes the company URL then the User can interact with the company via both voice and Internet (via browser 210) simultaneously.

[00254] The User "points and clicks" on a vending machine (target object 200) that is equipped with a connection to a network such as the Internet and that has a unique identifying mark, such as a number. The terminal 202 connects to the content server 211 of the company that operates the vending machine. The identification server identifies the particular vending machine by identifying and decoding the unique identifying mark. The identity of the particular machine is included in the target object information 209 and is sent from the terminal 202 to the content server 211. The content server 211, having the identification of the particular vending machine (target object 200), initiates communication with the vending machine. The User performs a transaction with the vending machine, such as purchasing a product, using his terminal 202 that communicates with the vending machine via the content server 211.

[00255] The User "points and clicks" on part of a machine, such as an aircraft part. The terminal 202 then displays information pertinent to the part, such as maintenance instructions or repair history.

[00256] The User "points and clicks" on a magazine or newspaper article and link to streaming audio or video content, further information, etc.

[00257] The User "points and clicks" on an automobile. The location of the terminal 206 is determined by a Global Position System receiver in the terminal 206, by cellular network radio ranging, or by another technique. The position of the terminal 202 is sent to the content server 211. The content server provides the User with information regarding the automobile, such as price and features, and furthermore, based on the position information, provides the User with the location of a nearby automobile dealer that sells the car. This same technique can be used to direct Users to nearby retail stores selling items appearing in magazine advertisements that Users "point and click" on.

[00258] For visually impaired people:

[00259] Click on any item in a store and the device speaks the name of the item and price to you (the items must be in the database).

[00260] Click on a newspaper or magazine article and the device reads the article to you.

[00261] Click on a sign (building, streetsign, etc.) and the device reads the sign to you and provides any addition pertinent information (the signs must be in the database).

[00262] **FIG. 6** shows an embodiment of the invention for spacecraft applications. In this embodiment, all components of the system (except the target object 300) are onboard a Spacecraft. The target object 300 is another spacecraft or object. This embodiment is used to determine the position and orientation of the target object 300 relative to the Spacecraft so that this information can be used in navigating, guiding, and maneuvering the spacecraft relative to the target object 300. An example use of this embodiment would be in autonomous spacecraft rendezvous and docking.

[00263] This embodiment determines the position and orientation of the target object 300, relative to the Spacecraft, as determined by the position, orientation, and size of the target object 300 in the imagery captured by the camera 303, by comparing the imagery with views of the target object 300 from different orientations that are stored in the database 308. The relative position and orientation of the target object 300 are output in the target object information, so that the spacecraft data system 310 can use this information in planning trajectories and maneuvers.

Industrial Applicability

[00264] The industrial applicability is anywhere that objects are to be identified by a digital optical representation of the object.

CLAIMS

What is claimed is:

1. A transaction system comprising:

a mobile device configured to acquire data related to an object;

an object identification platform configured to obtain the acquired data, recognize the object as a target object based on the acquired data, and determine object information associated with the target object; and

a content platform configured to obtain the object information, and initiate a transaction associated with the target object with a selected account over a network based on the object information.

2. The system of claim 1, wherein the mobile device is configured to operate, at least in part, as the object identification platform.

3. The system of claim 2, wherein the object identification platform is distributed between the mobile device and at least one remote server coupled with the mobile device via a network.

4. The system of claim 1, wherein a remote server coupled with the mobile device over a network is configured to operate as the object identification platform.

5. The system of claim 1, wherein the mobile device comprises the content platform.

6. The system of claim 1, wherein at least one remote server coupled with the mobile device over a network operates as the content platform.

7. The system of claim 1, wherein the content platform is further configured to provide content information pertinent to the target object to the mobile device based on the object information.

8. The system of claim 7, wherein the content information comprises video.

9. The system of claim 8, wherein the content information comprises a video stream.

10. The system of claim 7, wherein the content information comprises audio.

11. The system of claim 8, wherein the audio comprises an audio recording.

12. The system of claim 8, wherein the audio comprises an audio stream.

13. The system of claim 1, wherein the transaction comprises a commercial transaction.

14. The system of claim 13, wherein the commercial transaction includes a purchase related to the target object.

15. The system of claim 14, wherein the purchase relates to at least one of the following: audio data, video data, the object, the target object, a ticket, an item on a screen, a disc, a fare, and a vending machine product.

16. The system of claim 1, wherein the selected account comprises an on-line account.

17. The system of claim 1, wherein the selected account comprises an account linked with the mobile device.

18. The system of claim 1, wherein the selected account comprises an account linked to a user of the mobile device.

19. The system of claim 1, wherein the selected account comprises a bank account.

20. The system of claim 1, wherein the selected account comprises a credit card account.

21. The system of claim 1, wherein the acquired data comprises an image.

22. The system of claim 21, wherein the acquired data comprises image data.

23. The system of claim 1, wherein the acquired data comprises a digital representation relating to a person.

24. The system of claim 23, wherein the digital representation comprises a human face.

25. The system of claim 1, wherein the acquired data comprises user identify.

26. The system of claim 1, wherein the acquired data comprises location of the mobile device.

27. The system of claim 1, wherein the acquired data comprises screen content.

28. The system of claim 1, wherein the acquired data comprises a user voice command.

29. The system of claim 1, wherein the acquired data comprises symbol content.

30. The system of claim 29, wherein the symbol content comprises alphanumeric data.

31. The system of claim 1, wherein the object information comprises an object identity.

32. The system of claim 31, wherein the object identify comprises an object classification.

33. The system of claim 1, wherein the object information comprises an object status.

34. The system of claim 1, wherein the object information comprises decoded symbol information.

35. The system of claim 1, wherein the object information comprises an object attribute.

36. The system of claim 1, wherein the mobile device comprises a mobile telephone.

37. The system of claim 36, wherein the mobile device comprises a camera equipped mobile telephone.

38. The system of claim 1, wherein the mobile device comprises a vehicle.

ABSTRACT

A digital image of the object is captured and the object is recognized from plurality of objects in a database. An information address corresponding to the object is then used to access information and initiate communication pertinent to the object.

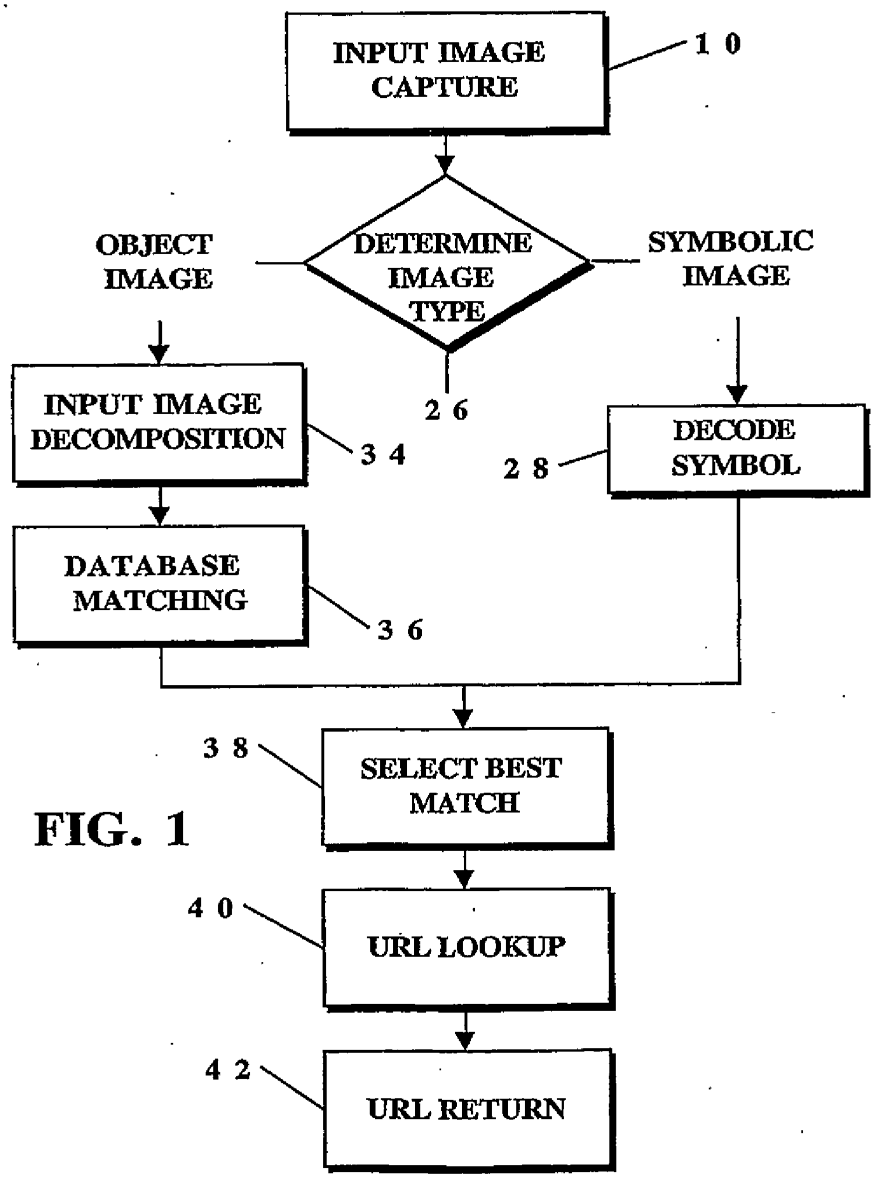
INPUT IMAGE CAPTURE
10
DETERMINE IMAGE TYPE
OBJECT IMAGE
SYMBOLIC IMAGE
26
INPUT IMAGE DECOMPOSITION
34
28
DECODE SYMBOL
DATABASE MATCHING
36
38
SELECT BEST MATCH
40
URL LOOKUP
42
URL RETURN

FIG. 1

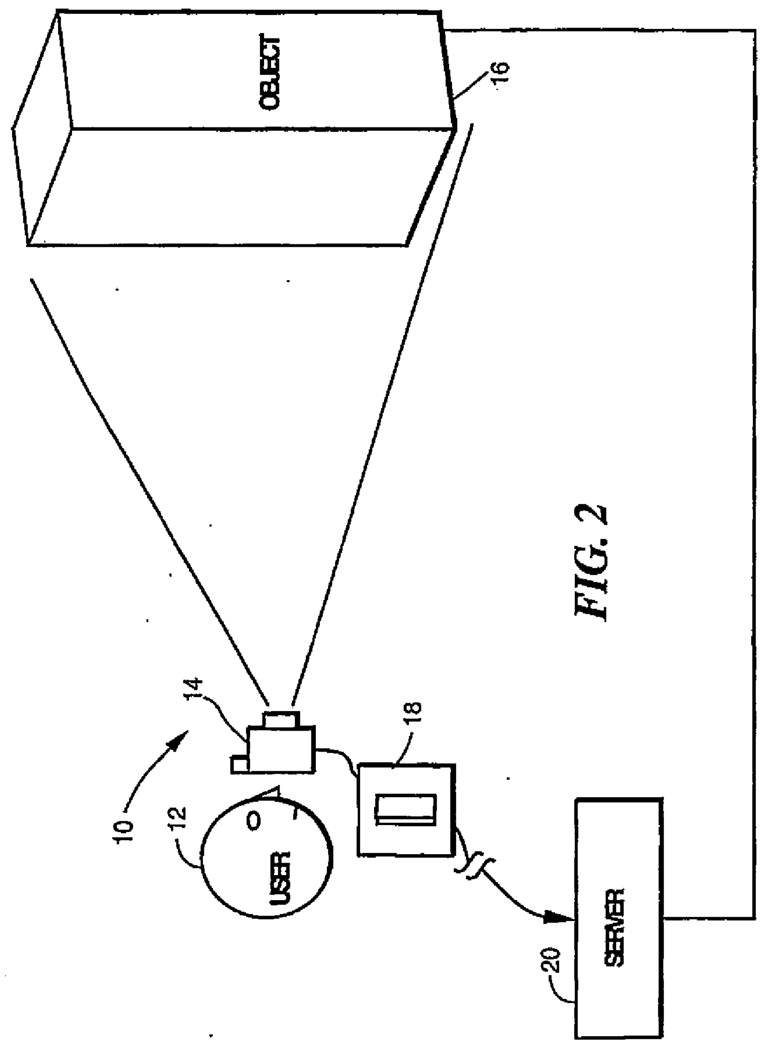

FIG. 2

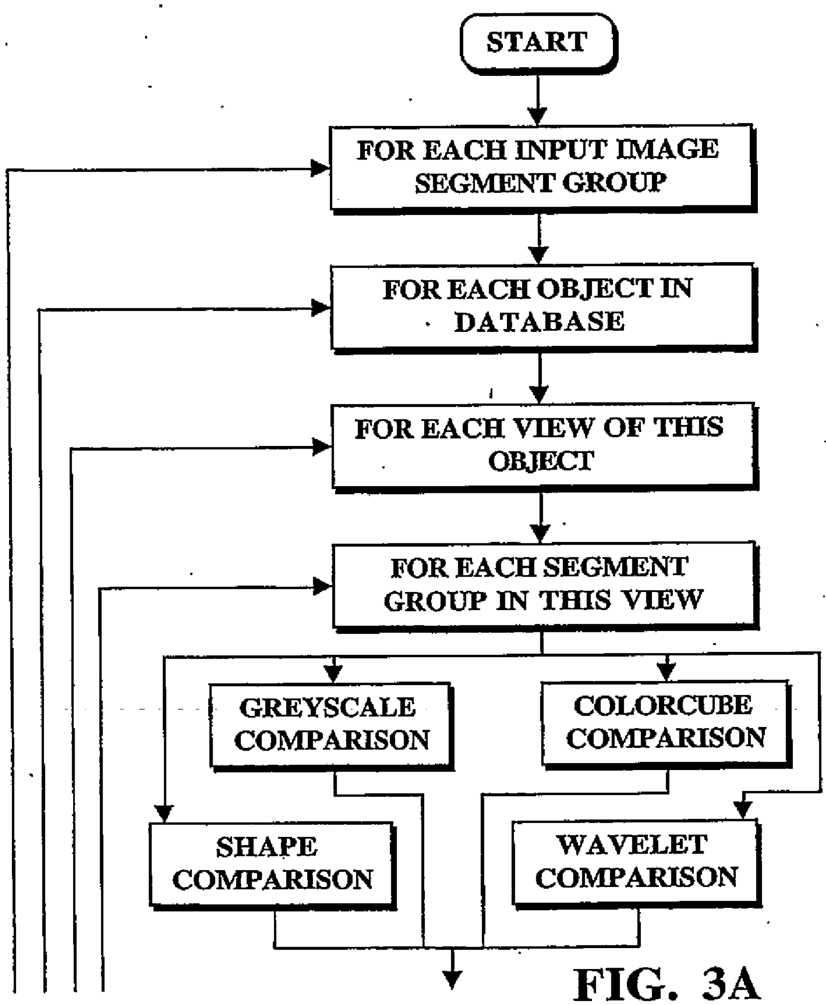
START
FOR EACH INPUT IMAGE SEGMENT GROUP
FOR EACH OBJECT IN DATABASE
FOR EACH VIEW OF THIS OBJECT
FOR EACH SEGMENT GROUP IN THIS VIEW
GREYSCALE COMPARISON
COLORCUBE COMPARISON
SHAPE COMPARISON
WAVELET COMPARISON

FIG. 3A

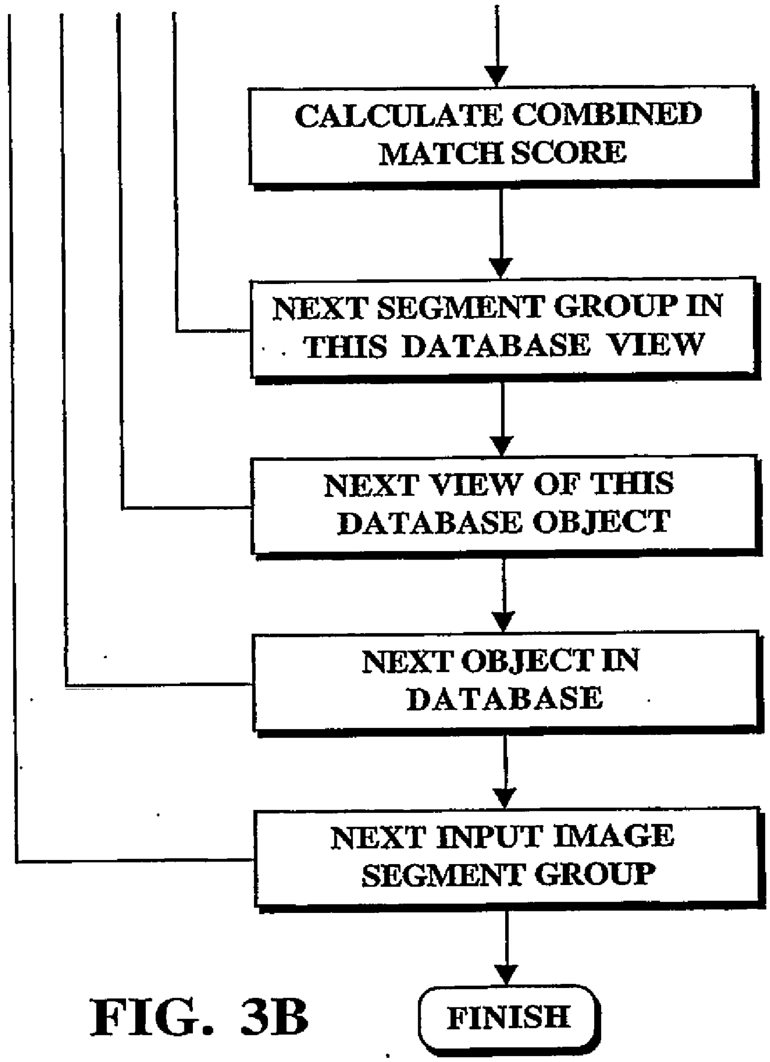
CALCULATE COMBINED MATCH SCORE
NEXT SEGMENT GROUP IN THIS DATABASE VIEW
NEXT VIEW OF THIS DATABASE OBJECT
NEXT OBJECT IN DATABASE
NEXT INPUT IMAGE SEGMENT GROUP
FINISH

FIG. 3B

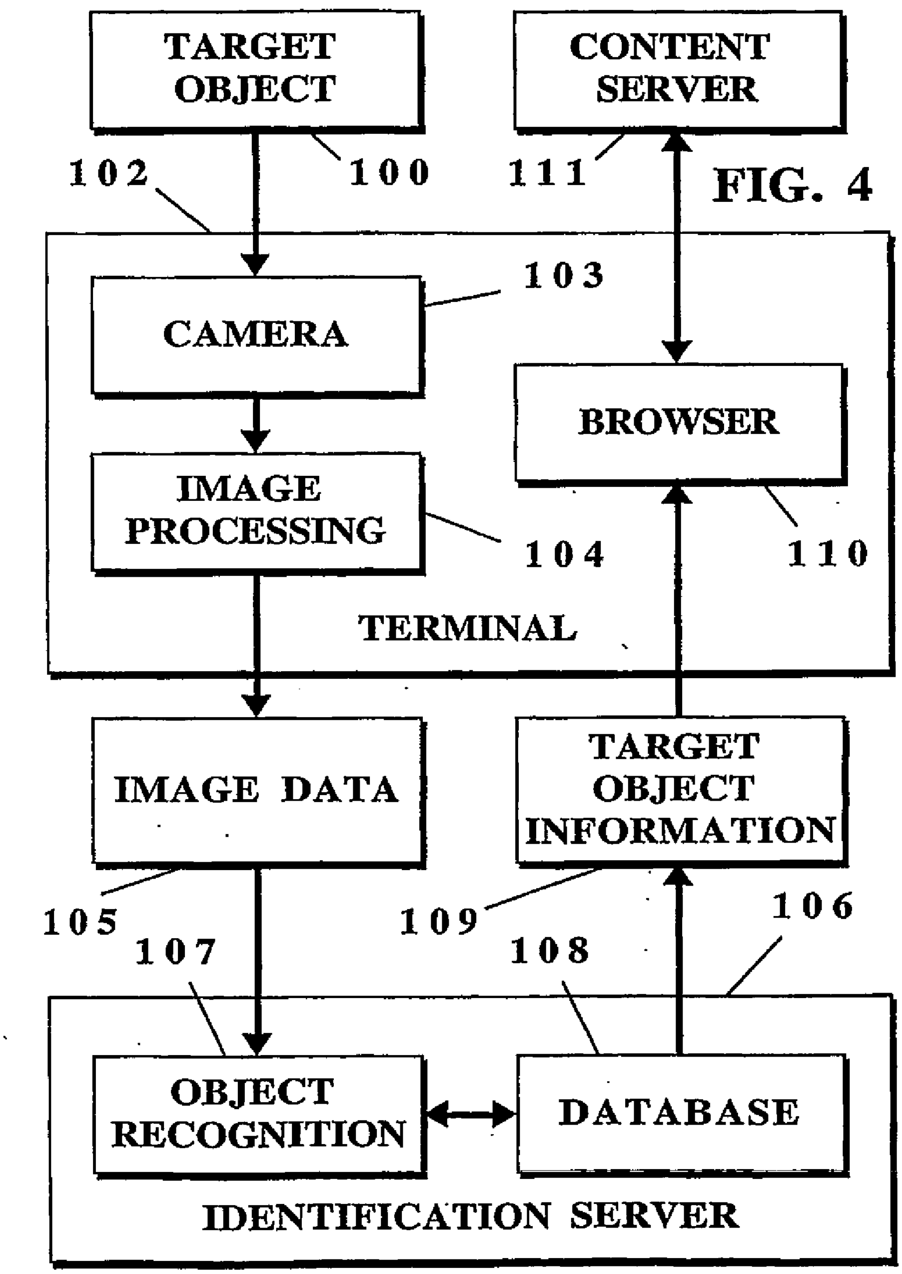
TARGET OBJECT
CONTENT SERVER
102
100
111
103
CAMERA
BROWSER
IMAGE PROCESSING
104
110
TERMINAL
IMAGE DATA
TARGET OBJECT INFORMATION
105
109
106
107
108
OBJECT RECOGNITION
DATABASE
IDENTIFICATION SERVER

FIG. 4

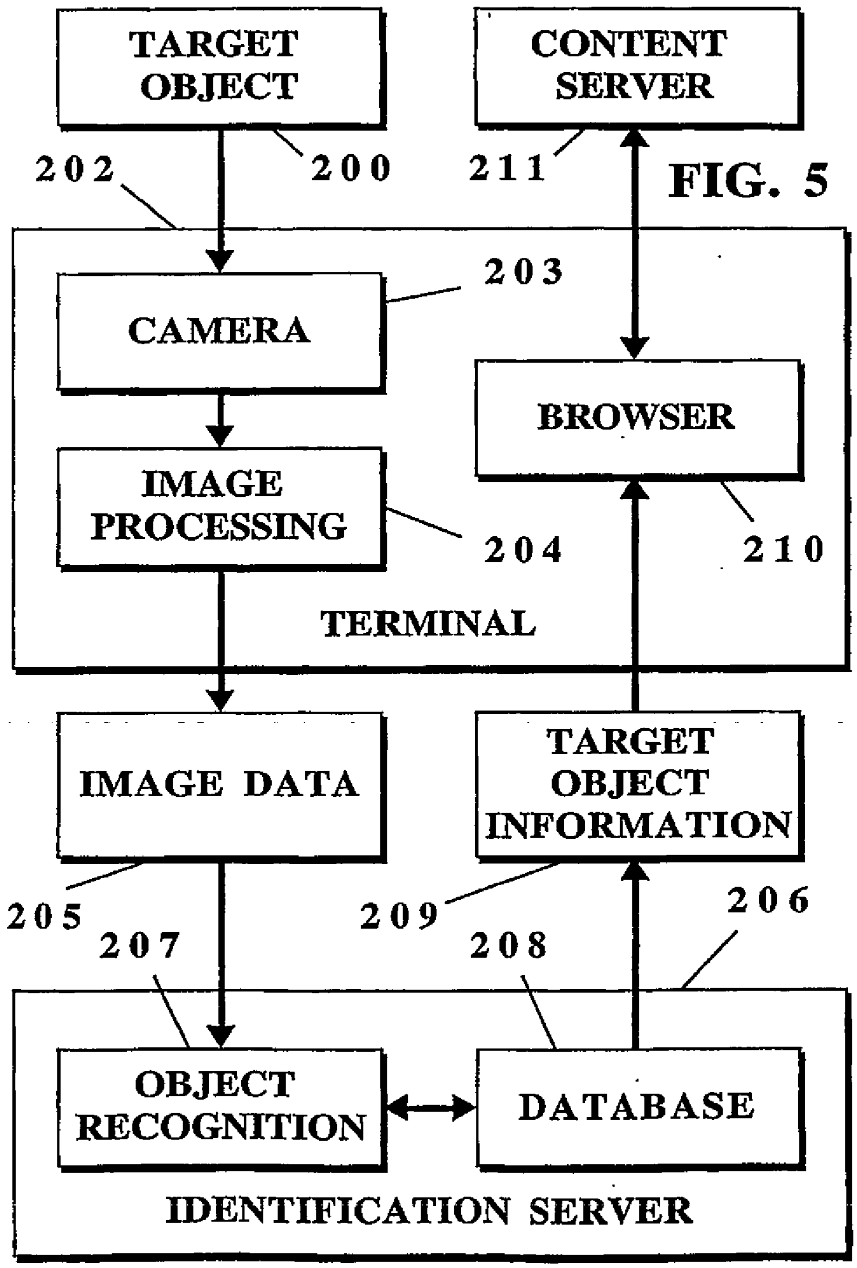
TARGET OBJECT
CONTENT SERVER
202
200
211
CAMERA
203
BROWSER
IMAGE PROCESSING
204
210
TERMINAL
IMAGE DATA
TARGET OBJECT INFORMATION
205
209
206
207
208
OBJECT RECOGNITION
DATABASE
IDENTIFICATION SERVER

FIG. 5

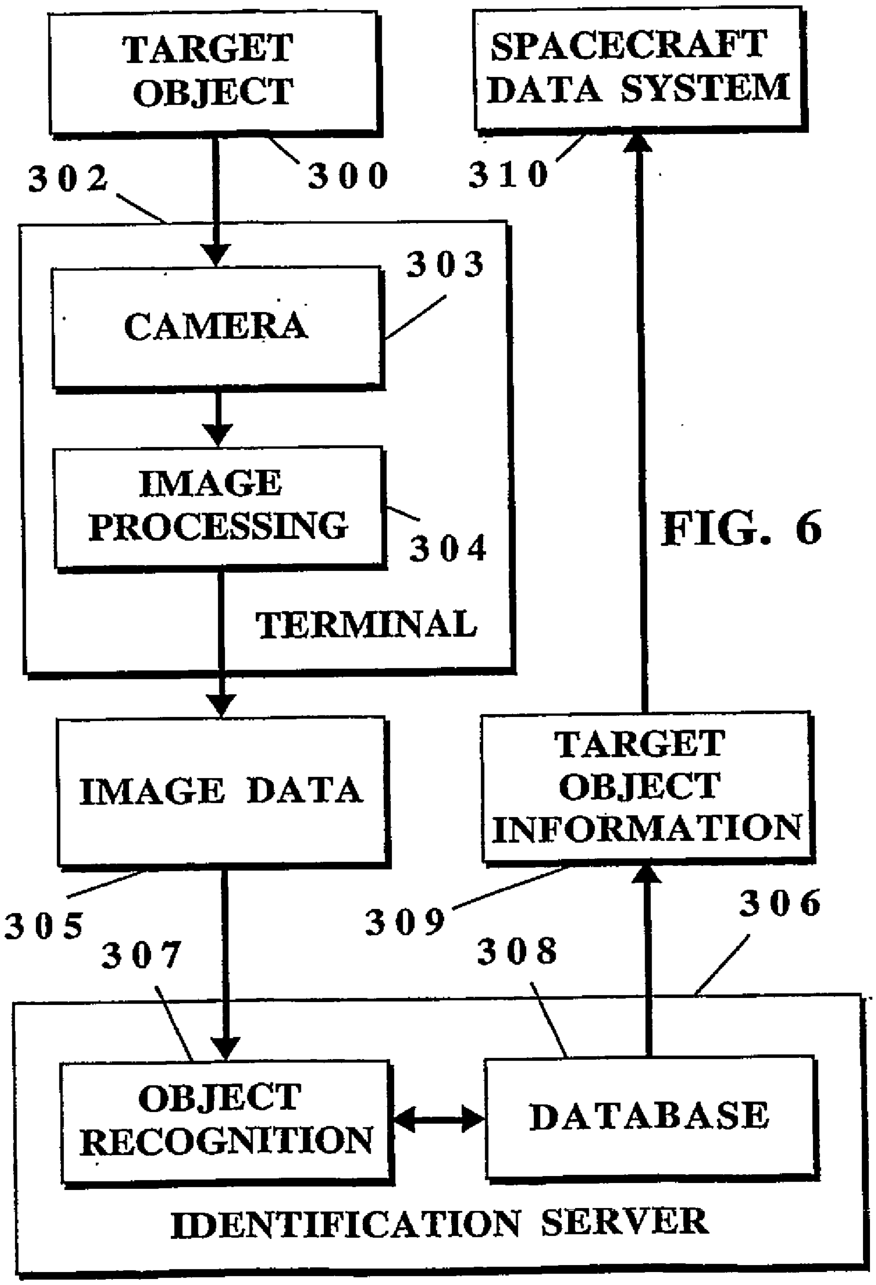
TARGET OBJECT
SPACECRAFT DATA SYSTEM
302
300
310
303
CAMERA
IMAGE PROCESSING
304
TERMINAL
IMAGE DATA
TARGET OBJECT INFORMATION
305
307
309
308
306
OBJECT RECOGNITION
DATABASE
IDENTIFICATION SERVER

FIG. 6

Electronic Acknowledgement Receipt

EFS ID:	10244089
Application Number:	13069124
International Application Number:	
Confirmation Number:	9532
Title of Invention:	Image Capture and Identification System and Process
First Named Inventor/Applicant Name:	Wayne C. Boncyk
Customer Number:	24392
Filer:	Martin Fessenmaier/Lindsey Ripley
Filer Authorized By:	Martin Fessenmaier
Attorney Docket Number:	101044.0001US14
Receipt Date:	06-JUN-2011
Filing Date:	22-MAR-2011
Time Stamp:	18:52:58
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Miscellaneous Incoming Letter	Statement_sub_spec.pdf	78686 e59e725ddeba6de53ba1e50ae965e77dca6f7887	no	1

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Information:

2		Application_01f_1US14.pdf	1403689 d35fcadb12d34f60f8e3289fd18238cebd3a8bf9	yes	52

Multipart Description/PDF files in .zip description

Document Description	Start	End
Specification	1	41
Claims	42	44
Abstract	45	45
Drawings-only black and white line drawings	46	52

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If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	13069124
	Filing Date	2011-03-22
	First Named Inventor	Wayne C. Boncyk
	Art Unit	
	Examiner Name	to be assigned
	Attorney Docket Number	101044.0001US14

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	5579471		1996-11-26	Barber et al.	
	2	5615324		1997-03-25	Kuboyama	
	3	5724579		1998-03-03	Suzuki	
	4	5751286		1998-05-12	Barber et al.	
	5	5768633		1998-06-16	Allen et al.	
	6	5926116		1999-07-20	Kitano et al.	
	7	5933823		1999-08-03	Cullen et al.	
	8	5933829		1999-08-03	Durst et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number: 13069124
	Filing Date: 2011-03-22
	First Named Inventor: Wayne C. Boncyk
	Art Unit:
	Examiner Name: to be assigned
	Attorney Docket Number: 101044.0001US14

	9	5978773		1999-11-02	Hudetz et al.	
	10	6055536		2000-04-25	Shimakawa et al.	
	11	6144848		2000-11-07	Walsh et al.	
	12	6181817		2001-01-30	Zabih et al.	
	13	6182090		2001-01-30	Peairs	
	14	6256409		2001-07-03	Wang	
	15	6286036		2001-09-01	Rhoads	
	16	6393147		2002-05-21	Danneels et al.	
	17	6396537		2002-05-28	Squilla et al.	
	18	6411725		2002-06-25	Rhoads	
	19	6453361		2002-09-17	Morris	

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	Filing Date	2011-03-22
	First Named Inventor	Wayne C. Boncyk
	Art Unit	
	Examiner Name	to be assigned
	Attorney Docket Number	101044.0001US14

	20	6522889		2003-02-18	Aarnio	
	21	6532298		2003-03-11	Cambier et al.	
	22	6567122		2003-05-20	Anderson et al.	
	23	6651053		2003-11-18	Rothschild	
	24	6674923		2004-01-06	Shih et al.	
	25	6674993		2004-01-06	Tarbouriech	
	26	6691914		2004-02-17	Isherwood et al.	
	27	6714969		2004-03-30	Klein et al.	
	28	6724914		2004-04-20	Brundage et al.	
	29	6738630		2004-05-18	Ashmore	
	30	6842181		2005-01-11	Acharya	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number		13069124
	Filing Date		2011-03-22
	First Named Inventor	Wayne C. Boncyk	
	Art Unit		
	Examiner Name	to be assigned	
	Attorney Docket Number		101044.0001US14

	31	6885771		2005-04-26	Takahashi	
	32	7016532		2006-03-21	Boncyk et al.	
	33	7362922		2008-04-22	Nishiyama et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code1	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20020019819		2002-02-14	Sekiguchi et al.	
	2	20020055957		2002-05-09	Ohsawa	
	3	20020089524		2002-07-11	Ikeda	
	4	20020090132		2002-07-11	Boncyk et al.	
	5	20020102966		2002-08-01	Lev et al.	
	6	20020103813		2002-08-01	Frigon	

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	Filing Date	2011-03-22
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	Examiner Name	to be assigned
	Attorney Docket Number	101044.0001US14

	7	20020140988		2002-10-03	Cheatle et al.	
	8	20020156866		2002-10-24	Schneider	
	9	20030095681		2003-05-22	Burg et al.	
	10	20040208372		2004-10-21	Boncyk et al.	
	11	20050015370		2005-01-20	Stavely et al.	
	12	20050162523		2005-07-28	Darrell et al.	
	13	20050185060		2005-08-25	Neven, Sr.	
	14	20080021953		2008-01-24	Gil	

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	1	0920179	EP		1999-06-02	Eastman Kodak Company		☐

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	Application Number	13069124
	Filing Date	2011-03-22
	First Named Inventor	Wayne C. Boncyk
	Art Unit	
	Examiner Name	to be assigned
	Attorney Docket Number	101044.0001US14

	2	1355258	EP		2003-10-22	Fujitsu Limited		☐
	3	2407230	GB		2005-04-20	OpenBlue Limited		☐
	4	1091634	JP		1998-04-10	写真画像検索システム		☐
	5	10289243	JP		1998-10-27	Casio Comput Co Ltd.		☐
	6	2001101191	JP		2001-04-13	Dacix Inc.		☐
	7	2001282825	JP		2001-10-12	Eighting:KK		☐
	8	0124050	WO		2001-04-05	Cadix Inc.		☐
	9	0173603	WO		2001-10-04	Kabushiki Kaisha Eighting		☐
	10	02082799	WO		2002-10-17	Lev et al.		☐
	11	0149056	WO		2001-07-05	Nokia Corporation		☐
	12	97/49060	WO		1997-12-24	Norand Corporation		☐

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	Filing Date	2011-03-22
	First Named Inventor	Wayne C. Boncyk
	Art Unit	
	Examiner Name	to be assigned
	Attorney Docket Number	101044.0001US14

	13	9916024	WO		1999-04-01	Raytheon Company		☐

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	Application Number	13069124
	Filing Date	2011-03-22
	First Named Inventor	Wayne C. Boncyk
	Art Unit	
	Examiner Name	to be assigned
	Attorney Docket Number	101044.0001US14

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Nicholas J. Witchey/	Date (YYYY-MM-DD)	2011-06-13
Name/Print	Nicholas J. Witchey	Registration Number	63481

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The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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(11) **EP 0 920 179 A3**

(12) **EUROPEAN PATENT APPLICATION**

(88) Date of publication A3:
13.09.2000 Bulletin 2000/37

(51) Int Cl.[7]: **H04N 1/00**, H04N 1/21

(43) Date of publication A2:
02.06.1999 Bulletin 1999/22

(21) Application number: **98203819.2**

(22) Date of filing: **12.11.1998**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **24.11.1997 US 977383**

(71) Applicant: **EASTMAN KODAK COMPANY**
Rochester, New York 14650 (US)

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Rochester, New York 14650-2201 (US)

(74) Representative: **Parent, Yves et al**
KODAK INDUSTRIE,
Département Brevets,
CRT - Zone Industrielle
71102 Chalon-sur-Saône Cedex (FR)

(54) **Photographic system involving data collection from a communicating scene**

(57) A photographic system involves the collection of data from a scene, e.g., a visitor attraction site, that is capable of interactive communication with a user. The attraction site stores content data related to the site, and the user communicates with the attraction site through a camera capable of communication with the site. Besides capturing an image associated with the site, the camera stores predetermined personality data that relates an interest of the user to at least a portion of the content data and includes means for transferring the personality data to the attraction site. The camera further includes means for receiving and displaying the portion of the content data from the attraction site, and a user interface for selecting from the displayed content data that part which the user wants to keep. In this manner, information relevant to a user's interests about a photographed item can be easily requested, accessed and stored with the specific pictures that the user has captured.

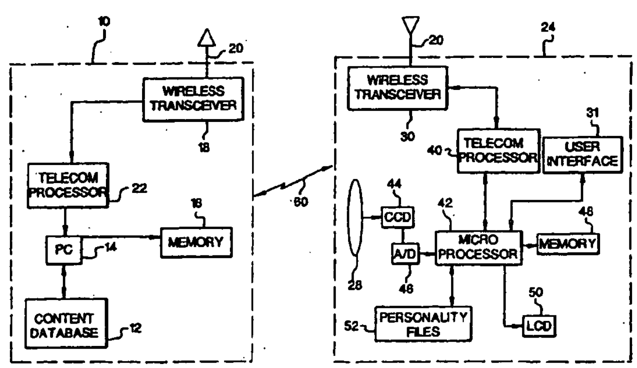

FIG. 1

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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 20 3819

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
P,X	US 5 768 633 A (ALLEN JAMES D ET AL) 16 June 1998 (1998-06-16) * the whole document *	1-29	H04N1/00 H04N1/21
X Y A	WO 97 26744 A (ROBB GARRY DOUGLAS) 24 July 1997 (1997-07-24) * abstract * * claims 1-6,21 *	1-8,11, 12,15 9,10,13, 14 16-29	
D,Y	EP 0 640 938 A (AT & T CORP) 1 March 1995 (1995-03-01) * abstract *	9,10	
D,Y	US 5 479 228 A (TAMAMURA HIDEO ET AL) 26 December 1995 (1995-12-26) * abstract *	13,14	
D,A	US 5 296 884 A (MORIMOTO YASUHIRO ET AL) 22 March 1994 (1994-03-22) * abstract *	1-29	TECHNICAL FIELDS SEARCHED (Int.Cl.6) H04N G06K G03B G03D G11B H04M
A	US 5 335 072 A (ISHIBE HIROSHI ET AL) 2 August 1994 (1994-08-02) * abstract *	1-29	
A	PATENT ABSTRACTS OF JAPAN vol. 1997, no. 07, 31 July 1997 (1997-07-31) & JP 09 065268 A (KYOCERA CORP), 7 March 1997 (1997-03-07) * abstract *	1-29	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 July 2000	Stoffers, C

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03 82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 98 20 3819

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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26-07-2000

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
US 5768633	A	16-06-1998	NONE			
WO 9726744	A	24-07-1997	AU	1363697	A	11-08-1997
			CA	2243244	A	24-07-1997
			CN	1208529	A	17-02-1999
			EP	0875109	A	04-11-1998
EP 0640938	A	01-03-1995	CA	2127765	A	25-02-1995
			CN	1109179	A	27-09-1995
			JP	7193646	A	28-07-1995
			US	5694514	A	02-12-1997
			US	5946444	A	31-08-1999
US 5479228	A	26-12-1995	JP	4246631	A	02-09-1992
			JP	4246634	A	02-09-1992
US 5296884	A	22-03-1994	JP	3247081	A	05-11-1991
US 5335072	A	02-08-1994	JP	4034311	A	05-02-1992
			JP	4070724	A	05-03-1992
			JP	4071069	A	05-03-1992
			JP	4071070	A	05-03-1992
			JP	4070725	A	05-03-1992
			JP	4070726	A	05-03-1992
			JP	4070288	A	05-03-1992
			JP	4070727	A	05-03-1992
			JP	4071068	A	05-03-1992
			JP	4070728	A	05-03-1992
			JP	2943263	B	30-08-1999
			JP	4070729	A	05-03-1992
			JP	4070730	A	05-03-1992
			JP	4070731	A	05-03-1992
			JP	4070732	A	05-03-1992
			JP	4070733	A	05-03-1992
			JP	2943264	B	30-08-1999
			JP	4070734	A	05-03-1992
			JP	2943265	B	30-08-1999
			JP	4070735	A	05-03-1992
			JP	4070225	A	05-03-1992
JP 09065268	A	07-03-1997	NONE			

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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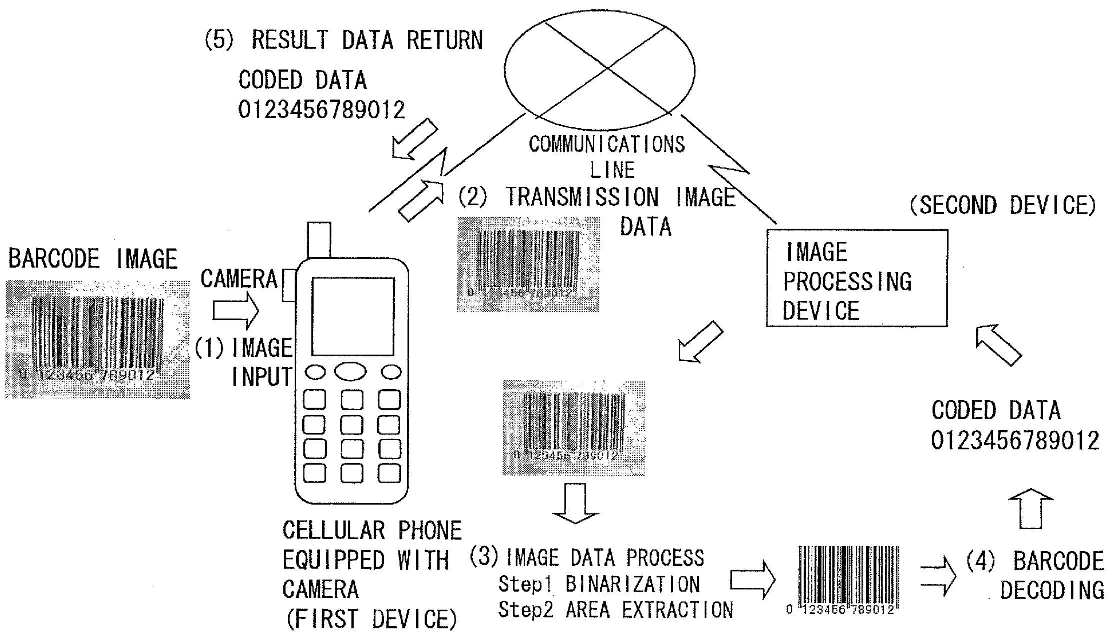
(54) **Image data processing devices and methods**

(57) After a preprocess such as a process for extracting a portion of an image is performed by a preprocessing unit for an image such as a barcode, etc., which is obtained (1) by an image data inputting unit within a first device such as a cellular phone equipped with a camera, etc., the image is transmitted (2) to a second device such as an image processing server, etc. via a communications path by an image data transmitting unit. In the second device, an image process (3, 4) such as barcode data decoding, etc. is performed, and result data is notified (5) to the first device via the communications path.



F I G. 3

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Description

[0001] The present invention relates to an image data processing device having an image input device, and more particularly, to a portable device that can be used with an image input device such as a camera, or the like, and a communications path.

[0002] In recent years, the use of the Internet by means of a cellular phone, a PDA (Personal Digital Assistant) , etc. has been increasing, and a cellular phone, a PDA, etc., which are quipped with an image input device such as a camera, etc. have been developed.

[0003] To read coded data such as a barcode, a two-dimensional barcode, etc., a terminal called a dedicated barcode reader is used.

[0004] Fig. 1 exemplifies the configuration of a conventional image input processing device such as a barcode reader, etc.

[0005] An image input processing device 10 such as a barcode reader, etc. comprises: an image data inputting unit 11 reading a barcode image; an image data processing unit 12 receiving the read image from the image data inputting unit 11, and performing a process for the image data; and a process result outputting unit 13 receiving a process result from the image data processing unit 12.

[0006] After binarizing the read barcode image, the image data processing unit 12 performs area extraction to only take out the barcode portion. Then, the image data processing unit 12 extracts the data possessed by the barcode by decoding the barcode, and inputs the extracted data to the process result outputting unit 13 as coded data.

[0007] The barcode reader performs an image process and a decoding (extraction) process for the barcode data for the barcode image obtained with the camera, and finally outputs the coded data stored in the barcode. For these processes, an MPU the throughput of which is relatively high, or a dedicated LSI, and software which performs a process specific to a barcode image are required.

[0008] Additionally, Japanese Patent Laid-Open Publication No. 2001-103188 cuts down a terminal cost by arranging a decoding capability for barcode data on a server which is connected to a terminal via a communications line, and by transmitting a barcode image itself to the server to process the image.

[0009] As described above, in the conventional example, an image process and a barcode data decoding process are performed by the MPU and the memory of a device itself. Therefore, if an input image is a large screen image, and a complex image process is performed when barcode data is attempted to be captured with a terminal having a processor of low throughput like a portable terminal, processing time increases. As a result, more of the computing power of the MPU is required, or the processes themselves cannot be performed due to a limitation on a memory area. Additionally, since also the software which performs a process specific to a barcode image is installed in the device itself, hardware resources such as a memory for storing the software becomes necessary, leading to an increase in the device cost.

[0010] If a decoding process for barcode data is performed by a server as disclosed by Japanese Patent Laid-Open Publication No. 2001-103188, a barcode image is transmitted as such. Therefore, the amount of communication data is large, so that communication cost and time increase. Furthermore, a result of the barcode process is not transmitted to a terminal or other devices. Especially, on the side of a terminal directly used by a user, barcode data or its associated information cannot be used.

[0011] It is desirable to provide an image data processing device capable of quickly performing complex image and information processes, even if the throughput (computing power or a memory space) of a device having an image input device is low, or software which performs a process specific to a barcode image, or the like is not installed.

[0012] It is also desirable to provide an image data processing device and a method thereof, with which a terminal user or a third party can freely use barcode data from which a process result is obtained, and its associated information.

[0013] An image data processing device according to an embodiment of a first aspect of the present invention comprises: an image data inputting unit inputting an image including coded data; a preprocessing unit performing a preprocess for the image; an image data transmitting unit transmitting the image data for which the preprocess is performed to a server that performs an image process via a communications path; and a process result receiving unit receiving the data resultant from the image process performed by the server via the communications path.

[0014] An image data processing method according to an embodiment of a second aspect of the present invention comprises: an image data inputting step inputting an image including coded data; a preprocessing step performing a preprocess for the image; an image data transmitting step transmitting the image data for which the preprocess is performed to a server that performs an image process via a communications path; and a process result receiving step receiving the data resultant from the image process performed by the server via the communications path.

[0015] In an embodiment of the present invention, after a preprocess is performed for an image, which is obtained by an image data processing device such as a cellular phone equipped with a camera, the image is transferred to a server that is connected via a communications path and performs an image process. Then, the server is made to perform the image process, and only a result of the image process is received by the image data processing device. Therefore, the amount of data becomes small at an image transfer, and the data can be quickly transferred. At the same time, a main process in the image process is performed by a server the throughput of which is high. Therefore, a result obtained by performing a desired data process can be quickly obtained even if the computing power or the memory space of the image data processing device is insufficient.

[0016] Reference will now be made, by way of example, to the accompanying drawings, in which:

Fig. 1 exemplifies the configuration of a conventional image input processing device such as a barcode reader;
Fig. 2 shows a first preferred embodiment according to the present invention;
Fig. 3 shows the outline of processes performed by devices in the first preferred embodiment according to the present invention;
Fig. 4 shows a second preferred embodiment according to the present invention;
Fig. 5 shows the outline of processes performed by devices in the second preferred embodiment according to the present invention;
Fig. 6 shows a third preferred embodiment;
Fig. 7 shows the outline of processes performed by devices in the third preferred embodiment according to the present invention;
Fig. 8 shows a fourth preferred embodiment according to the present invention;
Fig. 9 shows the outline of processes performed by devices in the fourth preferred embodiment according to the present invention;
Fig. 10 shows a fifth preferred embodiment according to the present invention; and
Fig. 11 shows the outline of processes performed by devices in the fifth preferred embodiment according to the present invention.

[0017] An image data processing device according to a preferred embodiment of the present invention is configured by: a first device having an information inputting unit inputting image information including coded data, a data transferring unit transferring the input data, and a process result receiving unit receiving a process result from a second device; and the second device having a data receiving unit receiving data, a data processing unit performing a process for the data, and a process result transmitting unit transmitting a result of the data processing unit to the first device. The first and the second devices are connected by a communications path, and mutually transmit/receive data.

[0018] Or, the image data processing device is configured by: a first device having an information inputting unit inputting image information including coded data, a data transferring unit transferring input data, and a process result receiving unit receiving a process result from a second device; and a second device having a data receiving unit receiving data, a data processing unit performing a process for the data, and a process result transmitting unit transmitting a result of the data processing unit to the first device. The first and the second devices are connected by a communications path, and mutually transmit/receive information. At the same time, information according to a result of the image processing unit within the second device is transmitted/received to/from a third device connected by a communications path.

[0019] Or, the image data processing device is configured by: a first device having an information inputting unit inputting image information including coded data, a data transferring unit transferring input data, and a process result receiving unit receiving a process result from a second device; and a second device having a data receiving unit receiving data, a data processing unit performing a process for the data, and a process result transmitting unit transmitting a result of the data processing unit to the first device. The first and the second devices are connected by a communications path, and mutually transmit/receive information.

[0020] The outline of the preferred embodiment according to the present invention is explained below.

[0021] First of all, a method applied in the case where an image whose data amount is large is obtained by a device (the first device) whose data throughput is relatively low, such as a camera, etc. is described.

[0022] Firstly, a barcode is input by the camera (the first device), an image process and barcode decoding are performed by a second device (an image processing server (a data processing device whose data throughput is high, and can transmit/receive data to/from the camera (the first device) via a communications path)), and information corresponding to the coded data stored in the barcode is received by the camera (the first device).

[0023] Image data is transmitted from the first device (the camera, a cellular phone, etc.) equipped with an image input device, whose available memory is limited, to the second processing device which is connected by a communications path and has a large memory, and a process result is obtained. In this way, an image process which requires a large memory can be performed even if the first device equipped with the image input device can be used with only a small memory.

[0024] Conventionally, in the first device such as a camera, a cellular phone, etc., a barcode image process and a barcode decoding process are performed in a barcode image process, and coded data stored in a barcode is extracted. A software library of 100 KB or more is required respectively for the barcode image process and the barcode decoding process. If a grayscale image of a CIF (Common Intermediate Format) size (352 by 288 pixels) is used as a barcode image, only this image requires 100-KB of memory.

[0025] The case where a cellular phone equipped with a camera is assumed to be used for a barcode process is considered. For the cellular phone, its computing power and memory area are mainly used for the transmission/reception of a telephone call, and a telephone book capability for telephone numbers. For an image input and an image process, an empty space is used, and the amount of available memory is limited to several hundred KB. Accordingly, an image process which requires a large memory, such as a barcode process, cannot be performed by the cellular phone alone.

[0026] In the meantime, an image server connected by a communications line can perform a barcode process, since it can be used with a high processing speed and a memory required for the process. Additionally, a software library of a barcode image process, a barcode decoding process, etc. is installed on the image server, thereby eliminating the need for storing the software library in the memory of the cellular phone.

[0027] Accordingly, data is transmitted/received between the cellular phone equipped with the camera and the image processing server via a communications line, whereby the image process which requires a large memory can be implemented.

[0028] The shortening of a communication time between the first and the second devices is described next.

[0029] A barcode is input by the first device such as a camera, etc., an image process and barcode decoding are performed by the second device (image processing server) , and coded data stored in the barcode is extracted and transmitted as such to the third device. If the first device equipped with an image input device transmits image data to the second processing device, and issues a request to perform a process to the third device connected by a communications path according to a process result, the process result of the second device is directly transmitted from the second device to the third device instead of transmitting the process result of the second device to the first device, which then issues the request to perform the process to the third device. As a result, a communication means can be simplified and made faster.

[0030] If shooting is made by a cellular phone equipped with a camera, the speeds of the communications paths between the first and the second devices, and between the first and the third devices are up to 1.2 KB/s (9600 bps: the communication speed of the cellular phone), whereas the communication speed of the second and the third devices, which are connected by the Internet, is 180 KB/s (1.5 Mbps: the communication speed of the third terminal (PC) connected to the Internet. ADSL in this case) . A big difference exists between the communication speeds.

[0031] If coded data is returned from the second device to the first device, it must be retransmitted from the first device to the third device that performs a database process so as to extract corresponding information. At this time, supplementary data such as the network address of the third device, etc. , which must be obtained from the second device, exist, and a communication amount on a low-speed communications path increases.

[0032] Accordingly, the coded data and the network address of the first device are directly transferred from the second device to the third device, corresponding information is prepared, and a process result is returned to the first device, so that an excess communication amount can be reduced.

[0033] Measures to speed up a communication process by performing a preprocess in a terminal is described below.

[0034] If a barcode is input by a camera, etc. (the first device), and a barcode image process and a barcode decoding process are performed by the second device (image processing server), grayscale image data input by the first device is transferred to the second device, by which the barcode image process and the barcode data decoding process are performed to extract coded data stored in the barcode. Here, in a preprocess within the barcode image process of the second device, an image binarization process whose processing load is light is performed by the first device, and not the grayscale image data but the binarized image data is transferred to the second device.

[0035] Part of the barcode image process that the second device is requested to perform is performed on the side of the first device equipped with an image input device, whereby the load on the second processing device ca be lightened, a transfer data size can be reduced, and a communication processing time can be shortened.

[0036] An image binarization process is approximately 5 percent of the whole of the barcode image process and the barcode decoding process. Process requests reach the server simultaneously from a plurality of first devices. In the case of a server that can simultaneously process requests from 20 first devices, the image binarization process is performed by the first devices beforehand, so that the server can simultaneously process the requests from the 20 first devices or more, leading to an increase in the speed of the server process. Additionally, the binarization process is performed by the first device, whereby a transfer image data size can be reduced to approximately 1/8 from 100 KB to 12 KB. If the communications path between the first and the second devices has a transmission speed of 1.2 KB/s (9600 bps), the transmission/reception time of 80 seconds is reduced to 10 seconds, which is 1/8, for grayscale image data. That is, 8-times high-speed transfer can be implemented.

[0037] Furthermore, measures to speed up a communication by performing a partial extraction process in a first terminal (the first device) is described below.

[0038] If a barcode is input by a camera, etc. (the first device), and a barcode image process and a barcode decoding process are performed by the second device (image processing server), grayscale image data input by the first device is transferred to the second device, by which the barcode image process and the barcode decoding process are performed to extract coded data stored in the barcode. Here, a process for extracting a portion from the barcode image data is performed by the first device, and the extracted portion is transferred to the second device.

[0039] As a result, a transfer data size can be reduced, and a communication processing time can be shortened.

[0040] In case of a barcode, especially, a one-dimensional barcode, a decoding process can be performed if there is at least data obtained by extracting a barcode symbol portion by one horizontal line. A portion of 352 by 1 pixels, which corresponds to the one horizontal line of the barcode symbol portion, is extracted from monochrome image data of the CIF (352 by 288 pixels) size, and transferred, so that a transfer image data size can be reduced to 1/288 from 100 KB to 0.3 KB of the gray-scale image data. However, decoding is unsuccessfully performed in some cases only with such an extracted portion. At this time, an instruction to extract and transmit another portion is issued from the second device to the first device. If decoding is successfully performed even after a transmission is repeated by n ($1<n<288$) times, a transfer image data size can be reduced to n/288. Additionally, instead of extracting another portion, a threshold value for the binarization process, which is performed by the first device, may be changed, and binarized image data may be transmitted to the second device.

[0041] Furthermore, measures to speed up a communication by performing an image compression process in a terminal is explained.

[0042] BMP compression (Japanese Patent Laid-Open Publication No. Hei 8-51545) is performed for data transmitted between the first device equipped with an image input device, and the second device that performs an image process, whereby transmission data can be reduced, and a communication time can be shortened.

[0043] The BMP compression is a bitmap data compression method (for further details, refer to Japanese Patent Laid-Open Publication No. Hei 8-51545), which can implement efficient data compression with a simple algorithm without requiring special hardware at a bitmap data transfer. For example, monochrome binary image data of the CIF size can be compressed to approximately 1/50 or smaller. Additionally, a compression/decompression process can be quickly performed in approximately 0.2 seconds. If the transmission speed of the communications path between the first and the second devices is 1.2 KB/s (9600 bps), transmission/reception time of 10 seconds in the case where an image is not compressed is reduced to 1/50 in the case where the image is compressed. Therefore, this 0.2 seconds plus the compression/decompression process time of 0.2 seconds is 0.4 seconds in total, which can implement 25-times speed-up.

[0044] A specific explanation is provided below with reference to the drawings.

[0045] In preferred embodiments, a process for a monochrome image is explained. For a color image, its monochrome image can be simply obtained if only luminance information is extracted from color information of a pixel. Therefore, the following preferred embodiments are applicable also to a color image.

[0046] Fig. 2 shows a first preferred embodiment according to the present invention, whereas Fig. 3 shows the outline of processes performed by devices.

[0047] In Fig. 2, a first device 20 such as a portable terminal equipped with an image input capability obtains image data. This obtainment is made by an image data inputting unit 22. The image data obtained by the image data inputting unit 22 is transmitted to an image data transmitting unit 23, and further transmitted to a second device 21 such as an image processing server, etc. via a communications path 29. The image data from the first device 20 is received by an image data receiving unit 26 within the second device 21, and the received image data is transmitted to a data processing unit 27. In the data processing unit 27, a barcode decoding process, etc., is performed. A result of the data process performed by the data processing unit 27 is transmitted to a process result transmitting unit 28, and further transmitted to the first device 20 via the communications path 29. In the first device 20, the transmitted process result is received by a process result receiving unit 24, passed to a process result outputting unit 25, and presented to a user of the first device 20 on a display (not shown).

[0048] Namely, image data input from the image data inputting unit such as a CMOS, a CCD sensor, etc., which is equipped by the first device, is transmitted to the second device connected by a communications path via the data transmitting unit. The image data received by the second device is held by the image data receiving unit. An image process, which is prespecified by the data processing unit (here, the barcode image process and the barcode decoding process), is performed for the held image data, and its result is transmitted to the process result transmitting unit. The result data is further transmitted to the first device via the communications path, and input to the process result outputting unit within the first device. In the first device, an image process result (coded data) can be obtained without performing an actual image process.

[0049] The flow of data is described more specifically with reference to Fig. 3. If a barcode is input as an image by a camera equipped by a cellular phone ((1)), this does not has any sense as it is. A process (decoding process) for converting the barcode image into coded data such as a numeral, a character, etc. embedded in the barcode, and for extracting the coded data from the barcode is required. Therefore, the image data is transmitted to the second device ((2)), and an image process and a decoding process, which are intended to convert the image data into coded data such as a numeral, a character, etc., are performed ((3) and (4)). In this preferred embodiment, the image process and the decoding process are performed by the second device (image processing server) connected by a communications path. In the second device (image processing server) , an image process such as a binarization process, a barcode area extraction process, etc. is performed for the received image data, and then, the decoding process is performed. Coded data resultant from the decoding process is returned to the transmission source ((5)). In the first device, the coded data returned from the second device (image processing server) is displayed on a screen, so that the contents of the barcode can be displayed. For a barcode, its coded data itself does not have a sense, and information that is stored in a database, etc. and corresponded to the coded data is more important and has a sense in many cases. Therefore, the information may be converted by the second device (image processing server), and the information corresponded to the coded data may be returned to the first device.

[0050] Fig. 4 shows a second preferred embodiment according to the present invention, whereas Fig. 5 shows the outline of processes performed by devices.

[0051] As shown in Fig. 4, if a first device 20 equipped with an image input device transmits image data to a second device 21, and issues a request to perform a process to a third device 30 connected by a communications path according to a process result, the process result of the second device 21 is directly transmitted to the third device 30 instead of issuing the request from the first device 20 to the third device 30. As a result, a communication means from the second device 21 to the first device 20 is simplified and made faster.

[0052] As shown in Fig. 5, a barcode image is input by the first device ((1)), barcode decoding is performed by the second device (image processing server) ((3) and (4)), and coded data is transmitted to the third device, which is a database processing device ((5)). Then, information corresponding to the coded data is extracted by the third device ((6)). If an output device such as a monitor, etc. is comprised by the third device, the information corresponding to the coded data can be verified on its screen. Or, if this information is verified by the first device, it is directly transmitted from the third device to the first device ((7)).

[0053] As described above, it achieves a simpler communication than the first embodiment in which only an image process (barcode decoding) is performed and the returned code data is returned to the third device again.

[0054] Fig. 6 shows a third preferred embodiment according to the present invention, whereas Fig. 7 shows the outline of processes performed by devices.

[0055] In Fig. 6, the same constituent elements as those shown in Fig. 2 are denoted with the same reference numerals, and their explanations are omitted.

[0056] Within a first device 20, a preprocessing unit 40, which performs a preprocess in an image process performed for image data, is arranged between an image data inputting unit 22 and an image data transmitting unit 23. In the preprocessing unit 40, for example, a process for extracting a portion from image data is performed, and the extracted portion is transferred to a second device 21. As a result, a transfer data size can be reduced, and a communication processing time can be shortened. Or, binarization may be performed as the preprocess. If a data processing unit 27 within the second device 21 fails to process the image data transmitted from the first device 20, it issues a request to extract and retransmit another portion to the preprocessing unit 40 within the first device 20 via a communications path (in the case where the process for extracting a portion from image data is performed as the preprocess). Or, in the case where binarization is performed as the preprocess, the data processing unit 27 within the second device 21 issues a request to retransmit a new binary image, which is obtained by changing a threshold value used for the binarization to a different value, to the preprocessing unit 40 within the first device 20 if it fails to process the image data.

[0057] Assume that barcode image data is input by the first device ((1)), and the process for extracting a portion from the barcode image data is performed as a preprocess ((2)) as shown in Fig. 7. In this case, the extracted barcode image data is transferred to the second device (image processing device) ((3)), by which an image process and a barcode decoding process are performed ((4) and (5)). If the barcode decoding process is unsuccessfully performed, an instruction to extract and retransmit another portion of the image data is issued from the second device (image processing device) to the first device (cellular phone equipped with a camera ((5')). When the barcode decoding process is successfully performed, resultant coded data is returned to the cellular phone equipped with the camera ((6)).

[0058] Fig. 8 shows a fourth preferred embodiment according to the present invention, whereas Fig. 9 shows the outline of processes performed by devices.

[0059] In Fig. 8, the same constituent elements as those shown in Fig. 6 are denoted with the same reference numerals, and their explanations are omitted.

[0060] As shown in Fig. 8, a data compressing unit 50 and a data decompressing unit 51, which are intended to compress and decompress transmission data in a data transmission made by a communications path 29 that connects a first device 20 and a second device 21, are arranged, whereby the amount of transmission data is reduced, and a communication time is shortened.

[0061] As shown in Fig. 9, a BMC coding method is used as an image data compression process in order to shorten an image data transmission time for an image process and a barcode decoding process, and image data to be transmitted/received is compressed, thereby shortening the transmission/reception time between the devices.

[0062] That is, in a cellular phone equipped with a camera (the first device), a barcode image is captured ((1)), and the input image is compressed by the BMC compression/decompression capability of the cellular phone equipped with the camera. Then, the compressed image data is transmitted to the second device (image processing device) via a communications line ((2)). In the image processing device, upon receipt of the compressed image, the image is decompressed, and an image data process is performed ((3)). In Fig. 9, binarization and area extraction are performed as the image process . However, these processes may be performed on the side of the first device. The barcode of the barcode image for which the image process is performed is decoded ((4)), coded data is extracted, and the extracted coded data is transmitted to the cellular phone equipped with the camera as data resultant from the image process ((5)).

[0063] An example where image binarization is performed as a preprocess, especially, an example where a two-dimensional barcode is handled is described below.

[0064] Fig. 10 shows a fifth preferred embodiment according to the present invention, whereas Fig. 11 shows the outline of processes performed by devices.

[0065] As coded data handled by the present invention, a one-dimensional barcode, a two-dimensional barcode, or data according to the one-dimensional or the two-dimensional barcode is assumed. This preferred embodiment refers to an example where a two-dimensional barcode is used. As a matter of course, the present invention is also applicable to a one-dimensional barcode in a similar manner.

[0066] In Fig. 10, the same constituent elements as those shown in Fig. 6 are denoted with the same reference numerals, and their explanations are omitted.

[0067] Within a first device 20, a preprocessing unit 40, which performs a preprocess in an image process performed for image data, is arranged between an image data inputting unit 22 and an image data transmitting unit 23. A color or a grayscale image obtained by reading an original including a two-dimensional barcode is input from the image data inputting unit 22. In the preprocessing unit 40, a binarization process for reducing gray levels of image data is performed. As a binarization process technique, a technique using the characteristic of a two-dimensional barcode as disclosed by Japanese Patent Laid-Open Publication No. 2001-251507 is used, so that the accuracy of a later decoding process, etc., can be improved. Additionally, by performing the binarization process, the size of image data is reduced to 1/24 (in the case where an original image is color). As a result, a transfer data size can be reduced, a communication processing time can be shortened, and a communication cost can be cut down.

[0068] The image data that is binarized and transferred to the second device 21 is transmitted to an image processing unit 27 within the second device 21, by which an image process and a barcode decoding process are performed. As an image process, a process for extracting a two-dimensional barcode area, or the like is performed. The technique using the characteristic of a two-dimensional barcode as disclosed by Japanese Patent Laid-Open Publication No. 2001-307014 is used also here, whereby a two-dimensional barcode area can be extracted more securely, and also the accuracy of barcode decoding is improved.

[0069] Note that the process for extracting a two-dimensional barcode area may be performed by a preprocessing unit 40 within the first device 20 as a preprocess. In this case, a transfer data size is further reduced, so that a communication processing time can be shortened, and a communication cost can be cut down. However, the algorithm of the process for extracting a two-dimensional barcode area is complex. Therefore, if the throughput of the first device 20 is much lower than that of the second device 21, an excess processing time is required, and can possibly exceed a shortened communication processing time. Accordingly, a process handled as the preprocess is suitably selected in consideration of the throughputs of the first device 20 and the second device 21.

[0070] In Fig. 11, an image including a two-dimensional barcode is obtained from a cellular phone equipped with a camera, which is the first device ((1)). Then, a preprocess such as binarization of the obtained image, or the like is performed ((2)), and the image data is transmitted to an image processing device, which is the second device, via a communications line ((3)). In the image processing device, an image data process such as area extraction from the received image, or the like is performed ((4)), the two-dimensional barcode is decoded and converted into coded data ((5)), and the coded data resultant from the image process is returned to the cellular phone equipped with the camera via the communications line ((6)).

[0071] As described above, according to one embodiment of the present invention, input image data including coded data of a device having an image input device is transmitted to an image processing server, and a process result is obtained, whereby it becomes possible to provide an image data processing device, which quickly performs a process of an image including complex coded data and its information process, even if the throughput of the device having the image input device is low.

Claims

1. An image data processing device, comprising:

   image data inputting means for inputting an image including coded data;
   preprocessing means for performing a preprocess for the image;
   image data transmitting means for transmitting

the image data for which the preprocess is performed to a server that performs an image process via a communications path; and
process result receiving means for receiving data resultant from the image process performed by the server via the communications path.

2. The image data processing device according to claim 1, wherein
the preprocess is binarization of an image.

3. The image data processing device according to claim 1, wherein
the preprocess is a process for extracting a portion of an image.

4. The image data processing device according to claim 1, wherein
an image compression process is performed as the preprocess.

5. The image data processing device according to any preceding claim, wherein
the server is configured by a plurality of image processing devices, one of which performs part of a process for image data transmitted from the image data processing device, the other image processing devices share and perform a remainder of the process, and an obtained result is returned to the image data processing device.

6. The image data processing device according to any preceding claim, wherein
the server makes the image data processing device retransmit the image for which the preprocess is performed under a different condition, if the server fails to perform an image process for the image which is transmitted from the image data processing device, and the preprocess is performed for.

7. The image data processing device according to claim 6, wherein
the different condition indicates that a threshold value for binarization is changed to a different value, if the binarization is performed as the preprocess.

8. The image data processing device according to claim 6, wherein
the different condition is to extract a different portion of an image if image extraction is performed as the preprocess.

9. The image data processing device according to any preceding claim, wherein
the image including the coded data is an image including an image of a barcode.

10. The image data processing device according to claim 9, wherein
the barcode is a two-dimensional barcode.

11. An image data processing method of an image data processing device, comprising the steps of:

inputting an image including coded data;
performing a preprocess for the image;
transmitting image data for which the preprocess is performed to a server that performs an image process via a communications path; and
receiving data resultant from the image process performed by the server via the communications path.

12. The image data processing method according to claim 11, wherein
the preprocess is binarization of an image.

13. The image data processing method according to claim 11, wherein
the preprocess is a process for extracting a portion of an image.

14. The image data processing method according to claim 11, wherein
an image compression process is performed as the preprocess.

15. The image data processing method according to any one of claims 11 to 14, wherein
the server is configured by a plurality of image processing devices, one of which performs part of a process for image data transmitted from an image data processing device, the other image processing devices share and perform a remainder of the process, and an obtained result is returned to the image data processing device.

16. The image data processing method according to any one of claims 11 to 15, wherein
if the server fails to process the image transmitted from said image data transmitting, for which the preprocess is performed, the server makes the image, for which the preprocess is performed under a different condition, retransmitted.

17. The image data processing method according to claim 16, wherein
the different condition indicates that a threshold value for binarization is changed to a different value, if the binarization is performed as the preprocess.

18. The image data processing method according to claim 16, wherein the different condition is to extract a different portion of an image if image extraction is performed as the preprocess.

19. The image data processing method according to any one of claims 11 to 18, wherein the image including the coded data is an image including an image of a barcode.

20. The image data processing method according to claim 19, wherein the barcode is a two-dimensional barcode.

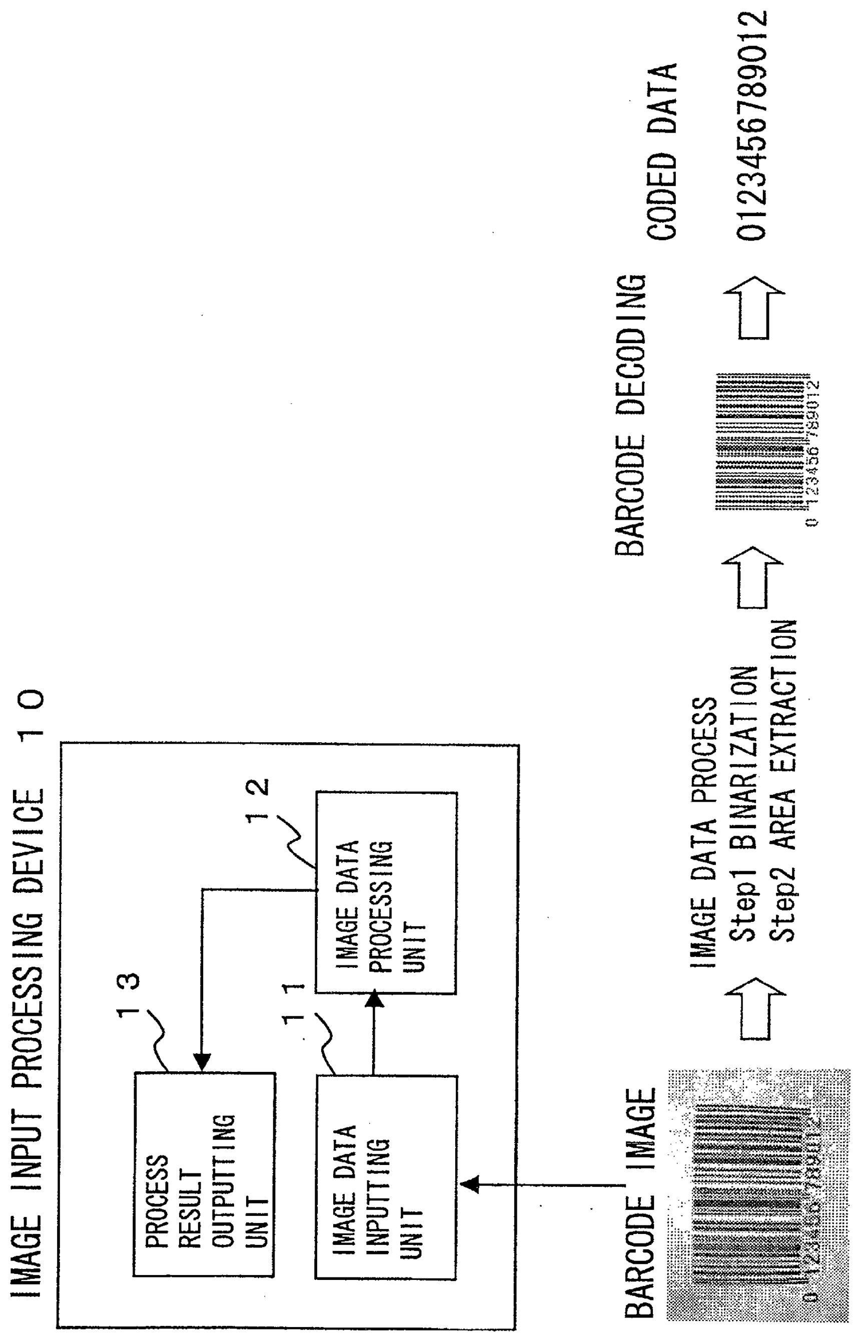


FIG. 1 PRIOR ART

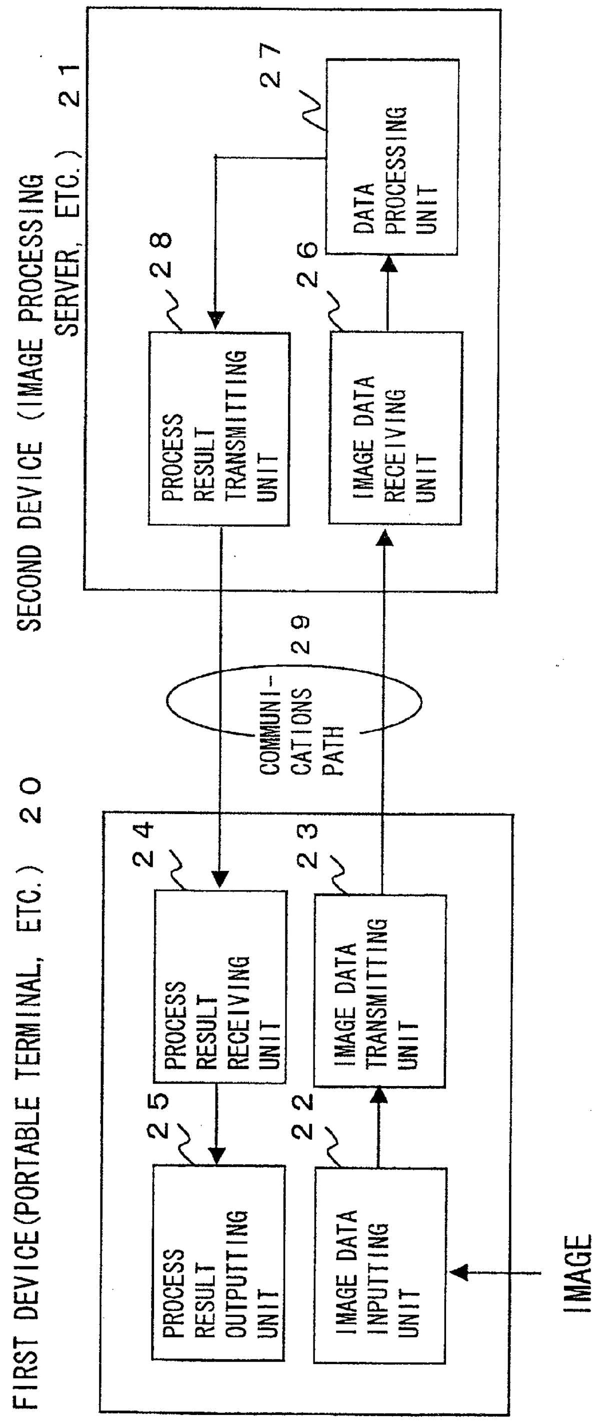
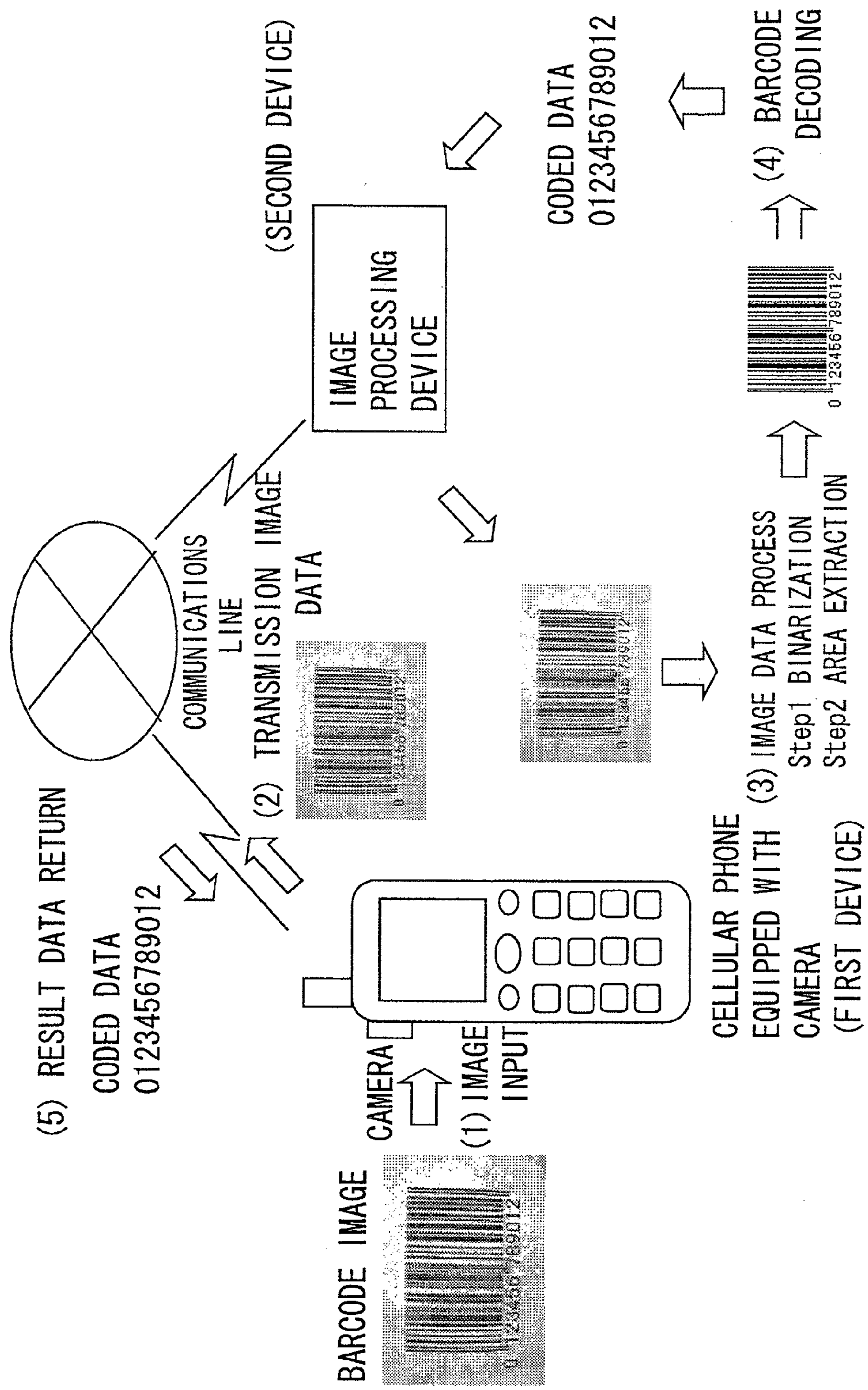
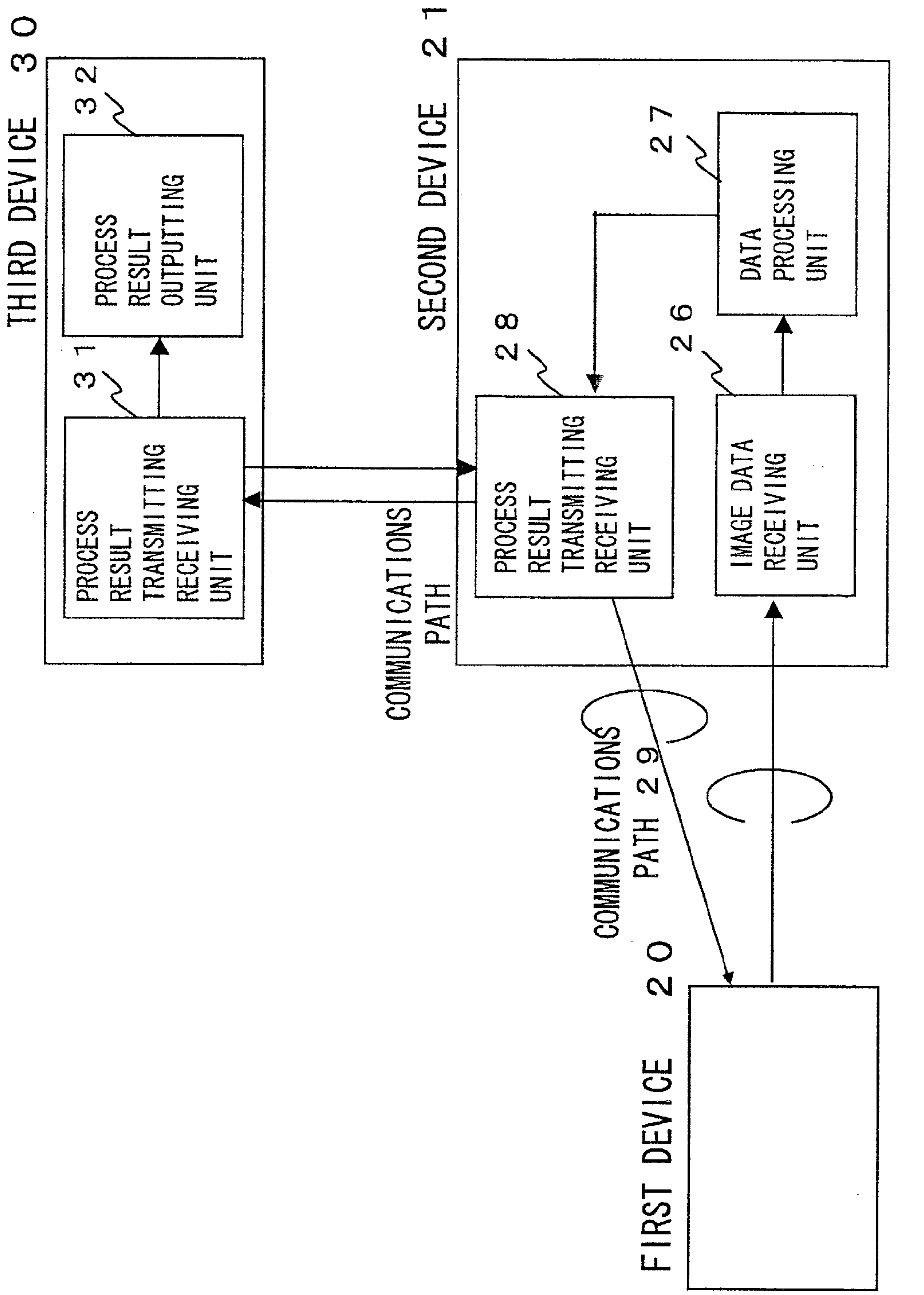

SECOND DEVICE (IMAGE PROCESSING SERVER, ETC.) 21
PROCESS RESULT TRANSMITTING UNIT
28
IMAGE DATA RECEIVING UNIT
26
DATA PROCESSING UNIT
27
COMMUNI-CATIONS PATH
29
FIRST DEVICE(PORTABLE TERMINAL, ETC.) 20
PROCESS RESULT RECEIVING UNIT
24
IMAGE DATA TRANSMITTING UNIT
23
PROCESS RESULT OUTPUTTING UNIT
25
IMAGE DATA INPUTTING UNIT
22
IMAGE

FIG. 2



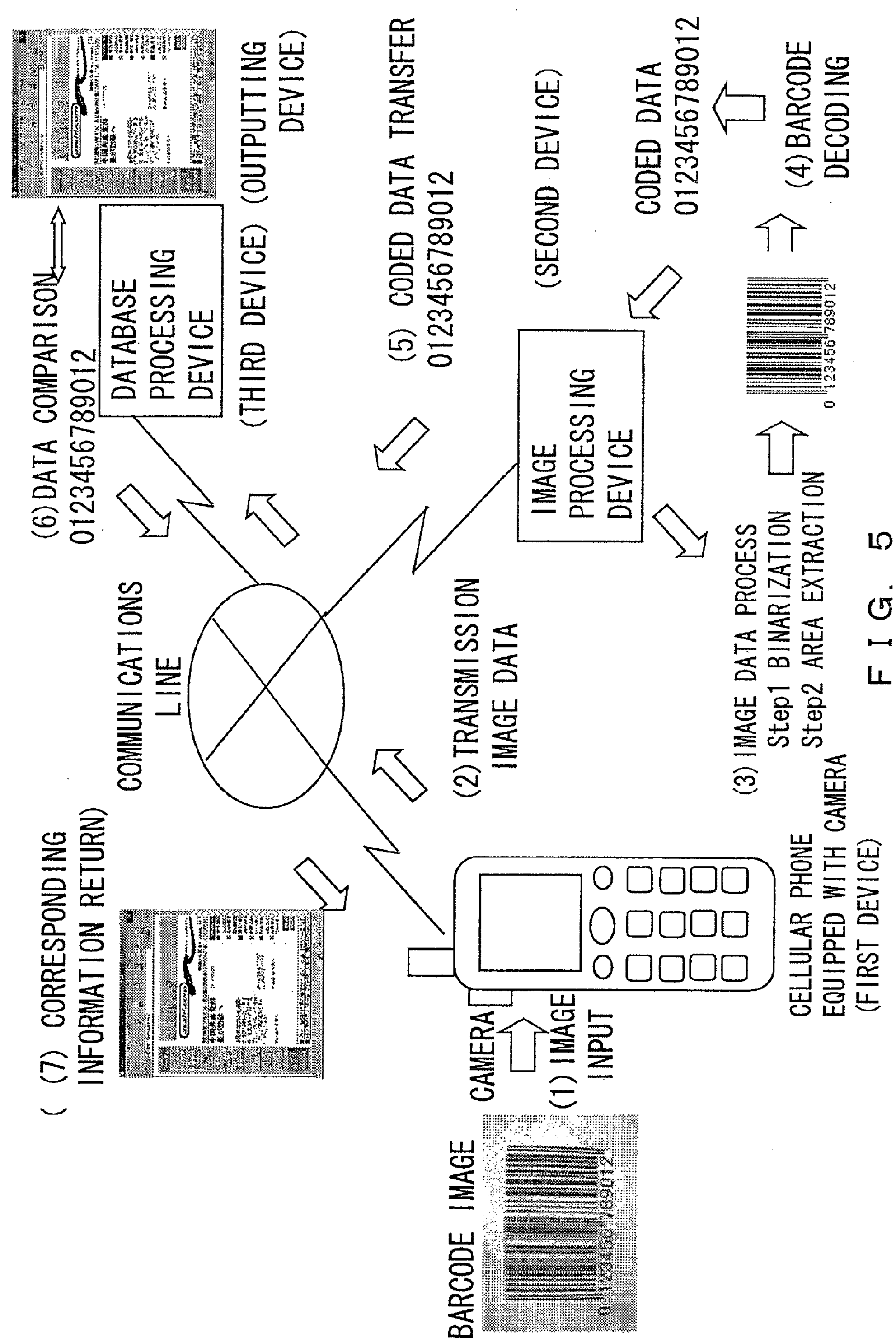
(5) RESULT DATA RETURN
CODED DATA
0123456789012
BARCODE IMAGE
CAMERA
(1) IMAGE INPUT
COMMUNICATIONS LINE
(2) TRANSMISSION IMAGE DATA
CELLULAR PHONE EQUIPPED WITH CAMERA (FIRST DEVICE)
IMAGE PROCESSING DEVICE
(SECOND DEVICE)
(3) IMAGE DATA PROCESS
Step1 BINARIZATION
Step2 AREA EXTRACTION
CODED DATA
0123456789012
(4) BARCODE DECODING

F I G. 3



THIRD DEVICE 30
32
PROCESS RESULT OUTPUTTING UNIT
31
PROCESS RESULT TRANSMITTING RECEIVING UNIT
COMMUNICATIONS PATH
SECOND DEVICE 21
27
DATA PROCESSING UNIT
28
PROCESS RESULT TRANSMITTING RECEIVING UNIT
26
IMAGE DATA RECEIVING UNIT
COMMUNICATIONS PATH 29
FIRST DEVICE 20

FIG. 4



BARCODE IMAGE
CAMERA
(1) IMAGE INPUT
CELLULAR PHONE EQUIPPED WITH CAMERA (FIRST DEVICE)
(2) TRANSMISSION IMAGE DATA
COMMUNICATIONS LINE
(7) CORRESPONDING INFORMATION RETURN)
IMAGE PROCESSING DEVICE
(SECOND DEVICE)
(3) IMAGE DATA PROCESS
Step1 BINARIZATION
Step2 AREA EXTRACTION
(4) BARCODE DECODING
CODED DATA 0123456789012
CODED DATA 0123456789012
(5) CODED DATA TRANSFER 0123456789012
DATABASE PROCESSING DEVICE
(THIRD DEVICE) (OUTPUTTING DEVICE)
(6) DATA COMPARISON 0123456789012

F I G. 5

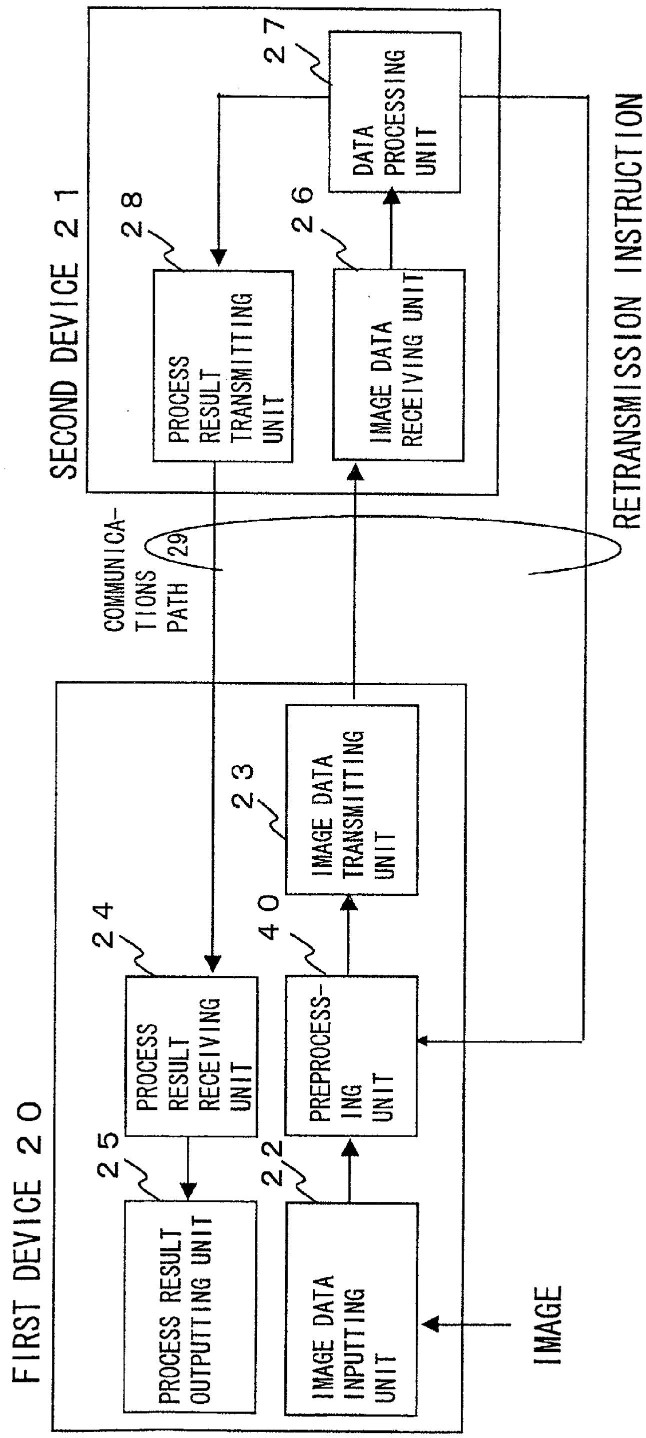
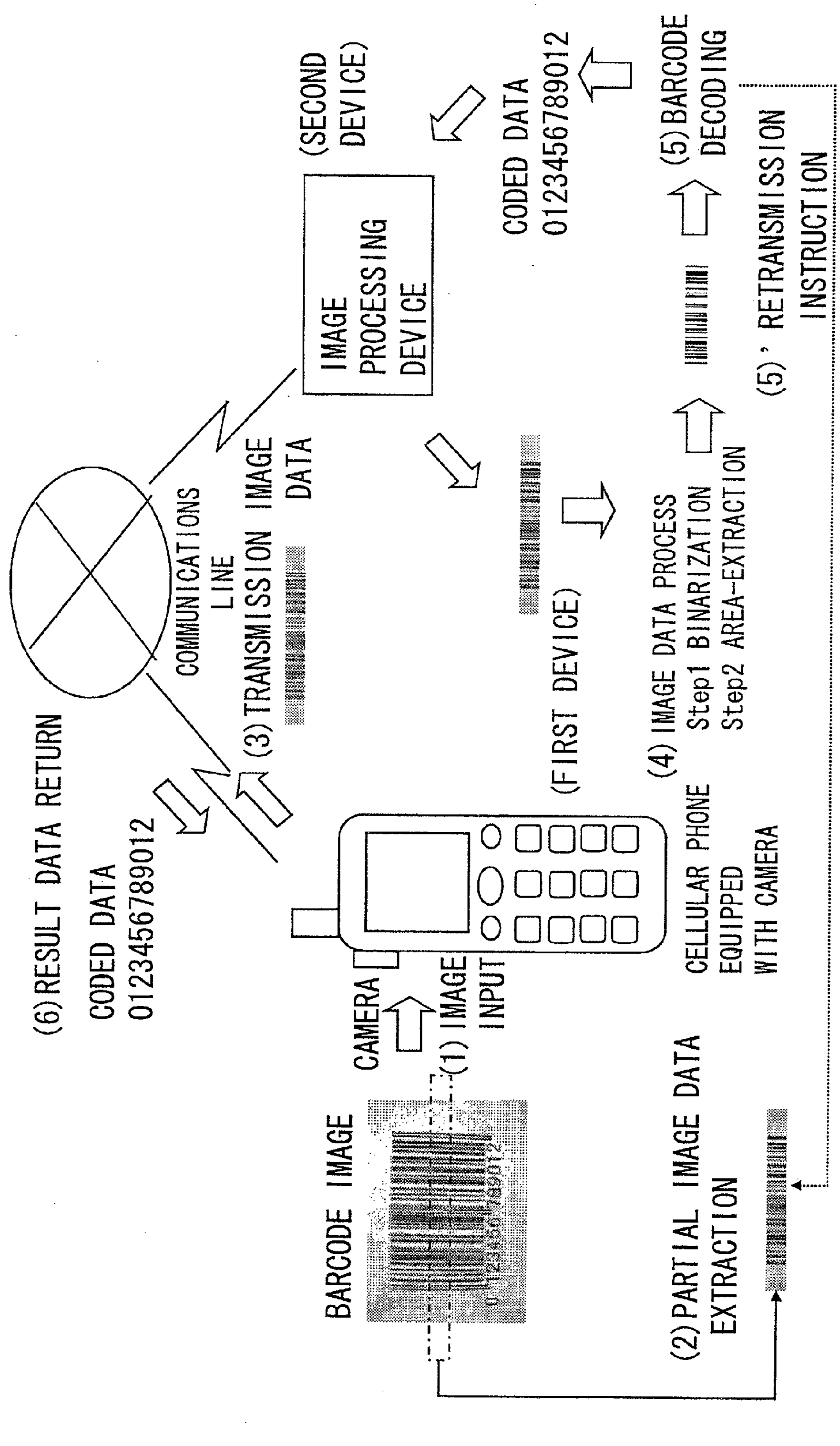
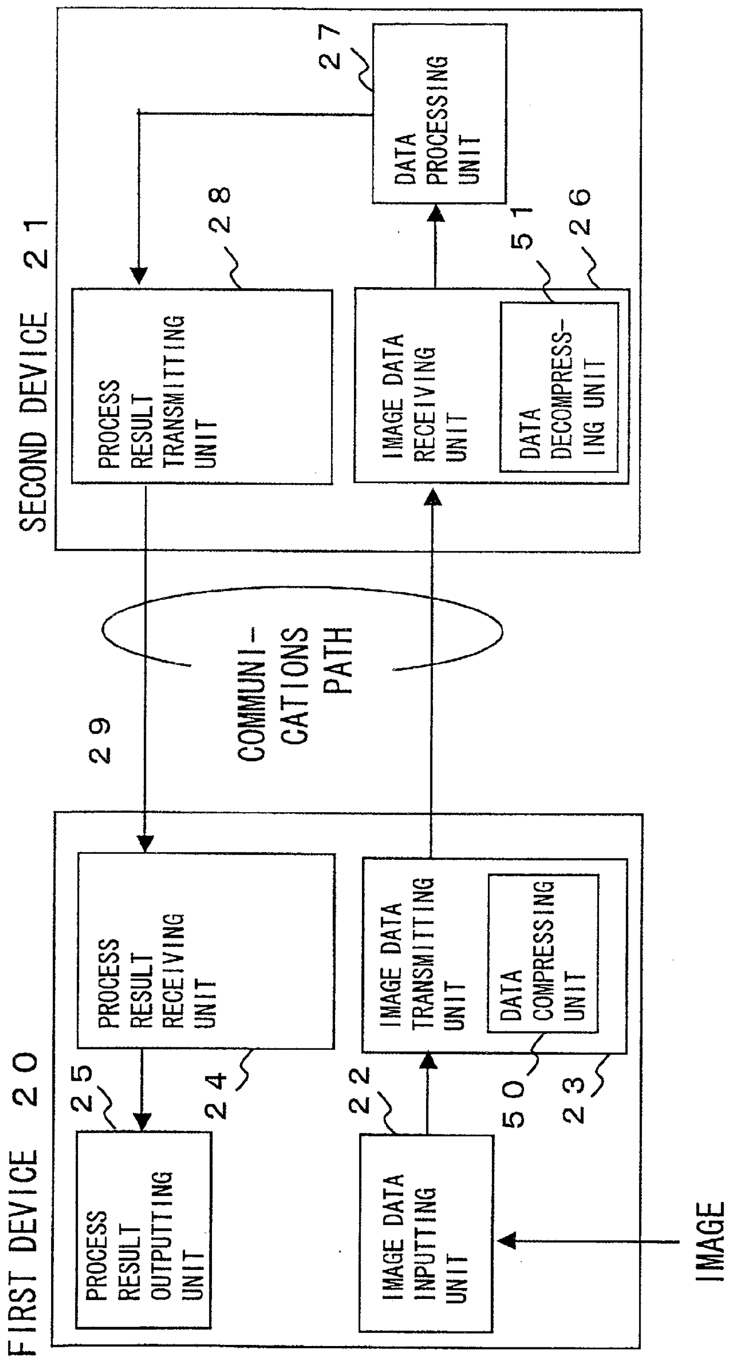

SECOND DEVICE 21
28
PROCESS RESULT TRANSMITTING UNIT
27
DATA PROCESSING UNIT
26
IMAGE DATA RECEIVING UNIT
RETRANSMISSION INSTRUCTION
COMMUNICA-TIONS PATH
29
FIRST DEVICE 20
24
PROCESS RESULT RECEIVING UNIT
25
PROCESS RESULT OUTPUTTING UNIT
23
IMAGE DATA TRANSMITTING UNIT
40
PREPROCESS-ING UNIT
22
IMAGE DATA INPUTTING UNIT
IMAGE

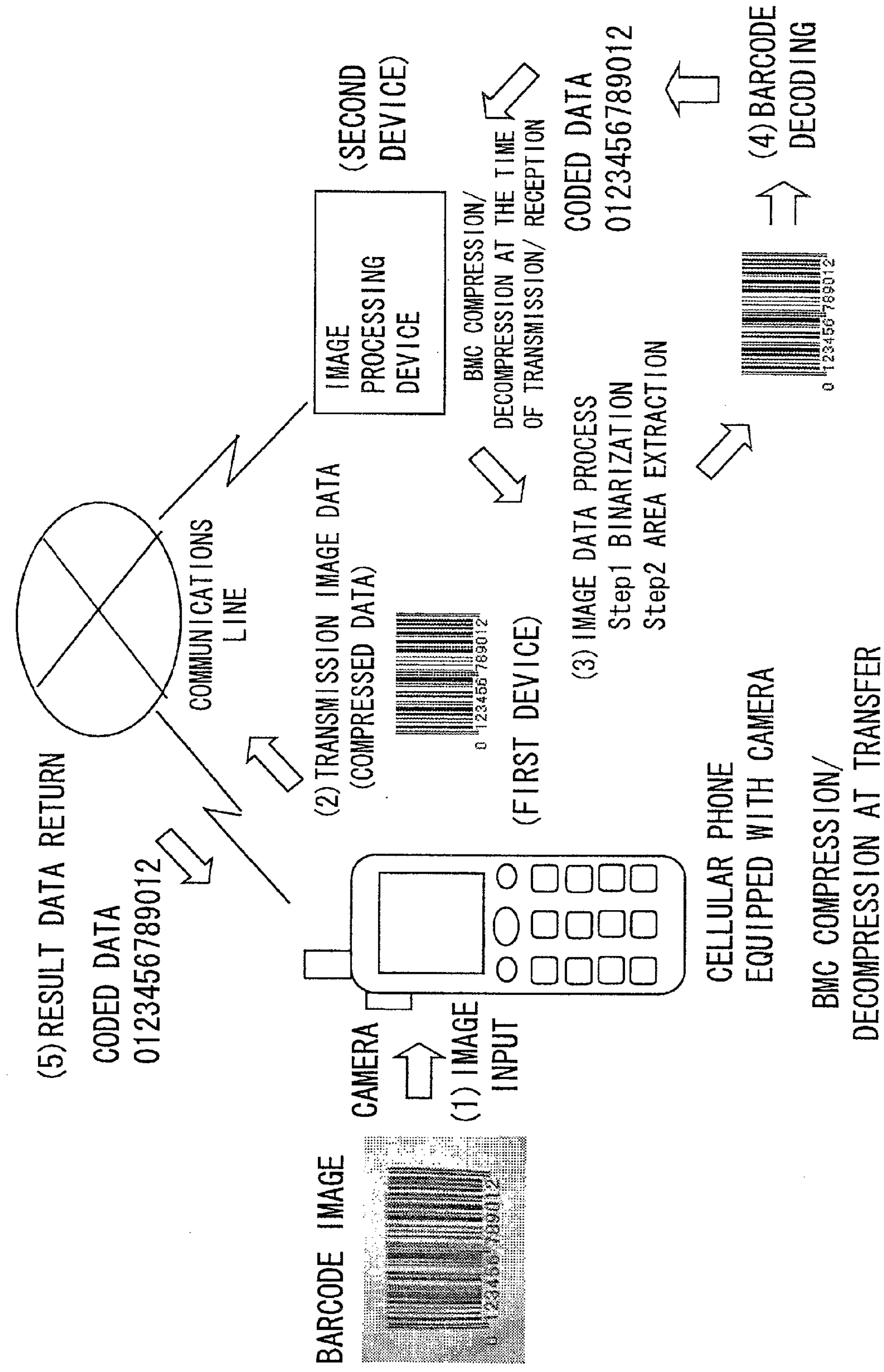
FIG. 6


BARCODE IMAGE
CAMERA
(1) IMAGE INPUT
(2) PARTIAL IMAGE DATA EXTRACTION
CELLULAR PHONE EQUIPPED WITH CAMERA
(FIRST DEVICE)
(3) TRANSMISSION IMAGE DATA
COMMUNICATIONS LINE
(6) RESULT DATA RETURN
CODED DATA
0123456789012
IMAGE PROCESSING DEVICE
(SECOND DEVICE)
(4) IMAGE DATA PROCESS
Step1 BINARIZATION
Step2 AREA-EXTRACTION
(5) BARCODE DECODING
(5)' RETRANSMISSION INSTRUCTION
CODED DATA
0123456789012

F I G. 7


SECOND DEVICE 21
PROCESS RESULT TRANSMITTING UNIT
28
DATA PROCESSING UNIT
27
IMAGE DATA RECEIVING UNIT
DATA DECOMPRESS-ING UNIT
51
26
COMMUNI-CATIONS PATH
29
FIRST DEVICE 20
PROCESS RESULT OUTPUTTING UNIT
25
PROCESS RESULT RECEIVING UNIT
24
IMAGE DATA INPUTTING UNIT
22
IMAGE DATA TRANSMITTING UNIT
DATA COMPRESSING UNIT
50
23
IMAGE

F I G. 8


BARCODE IMAGE
CAMERA
(1) IMAGE INPUT
(5) RESULT DATA RETURN
CODED DATA
0123456789012
COMMUNICATIONS LINE
(2) TRANSMISSION IMAGE DATA (COMPRESSED DATA)
(FIRST DEVICE)
CELLULAR PHONE EQUIPPED WITH CAMERA
BMC COMPRESSION/ DECOMPRESSION AT TRANSFER
IMAGE PROCESSING DEVICE
(SECOND DEVICE)
BMC COMPRESSION/ DECOMPRESSION AT THE TIME OF TRANSMISSION/ RECEPTION
(3) IMAGE DATA PROCESS
Step1 BINARIZATION
Step2 AREA EXTRACTION
CODED DATA
0123456789012
(4) BARCODE DECODING

F I G. 9

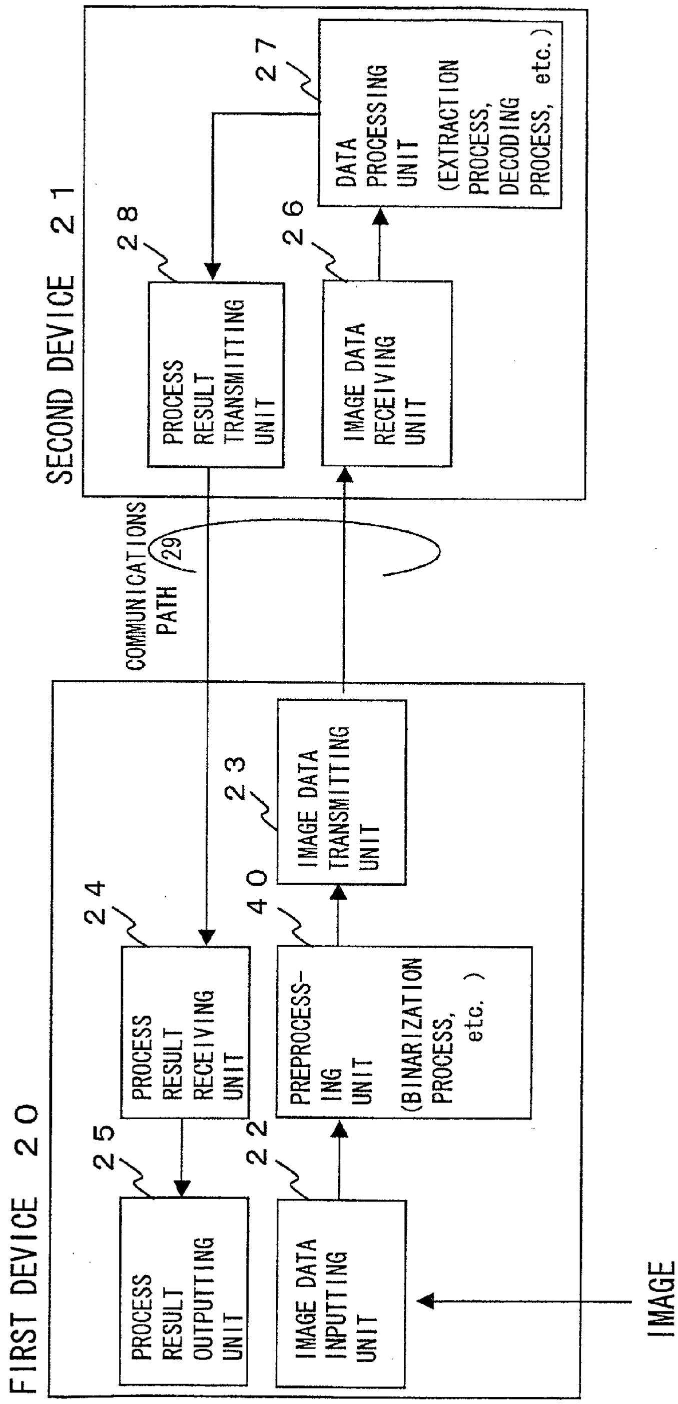

SECOND DEVICE 21
PROCESS RESULT TRANSMITTING UNIT
28
IMAGE DATA RECEIVING UNIT
26
DATA PROCESSING UNIT (EXTRACTION PROCESS, DECODING PROCESS, etc.)
27
COMMUNICATIONS PATH
29
FIRST DEVICE 20
PROCESS RESULT OUTPUTTING UNIT
25
PROCESS RESULT RECEIVING UNIT
24
IMAGE DATA INPUTTING UNIT
22
PREPROCESSING UNIT (BINARIZATION PROCESS, etc.)
40
IMAGE DATA TRANSMITTING UNIT
23
IMAGE

FIG. 10

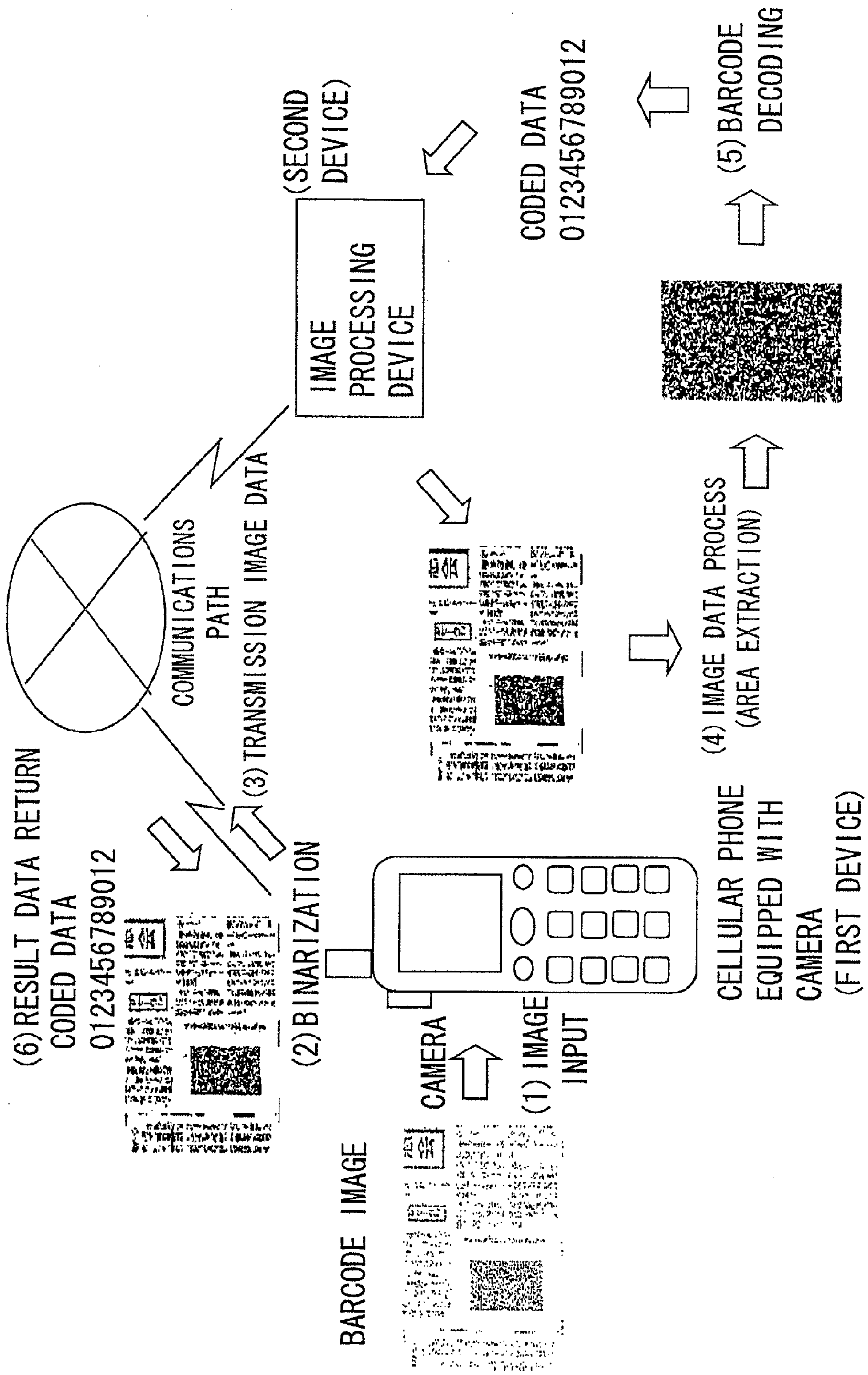

(6) RESULT DATA RETURN
CODED DATA
0123456789012
(2) BINARIZATION
(3) TRANSMISSION IMAGE DATA
COMMUNICATIONS PATH
IMAGE PROCESSING DEVICE
(SECOND DEVICE)
CODED DATA
0123456789012
(5) BARCODE DECODING
(4) IMAGE DATA PROCESS
(AREA EXTRACTION)
BARCODE IMAGE
CAMERA
(1) IMAGE INPUT
CELLULAR PHONE EQUIPPED WITH CAMERA
(FIRST DEVICE)

FIG. 11

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(51) INT CL^7:
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(52) UK CL (Edition X):
H4L LDPB L205

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GB 2356321 A
WO 2002/093290 A2
WO 2000/049530 A1
WO 2000/014640 A1
US 20020022488 A1
WO 2002/102025 A1
WO 2002/035798 A1
WO 2000/044119 A1
US 20030008661 A1

(58) Field of Search:
UK CL (Edition X) **H4L**
INT CL^7 **G06F, H04Q**
Other:

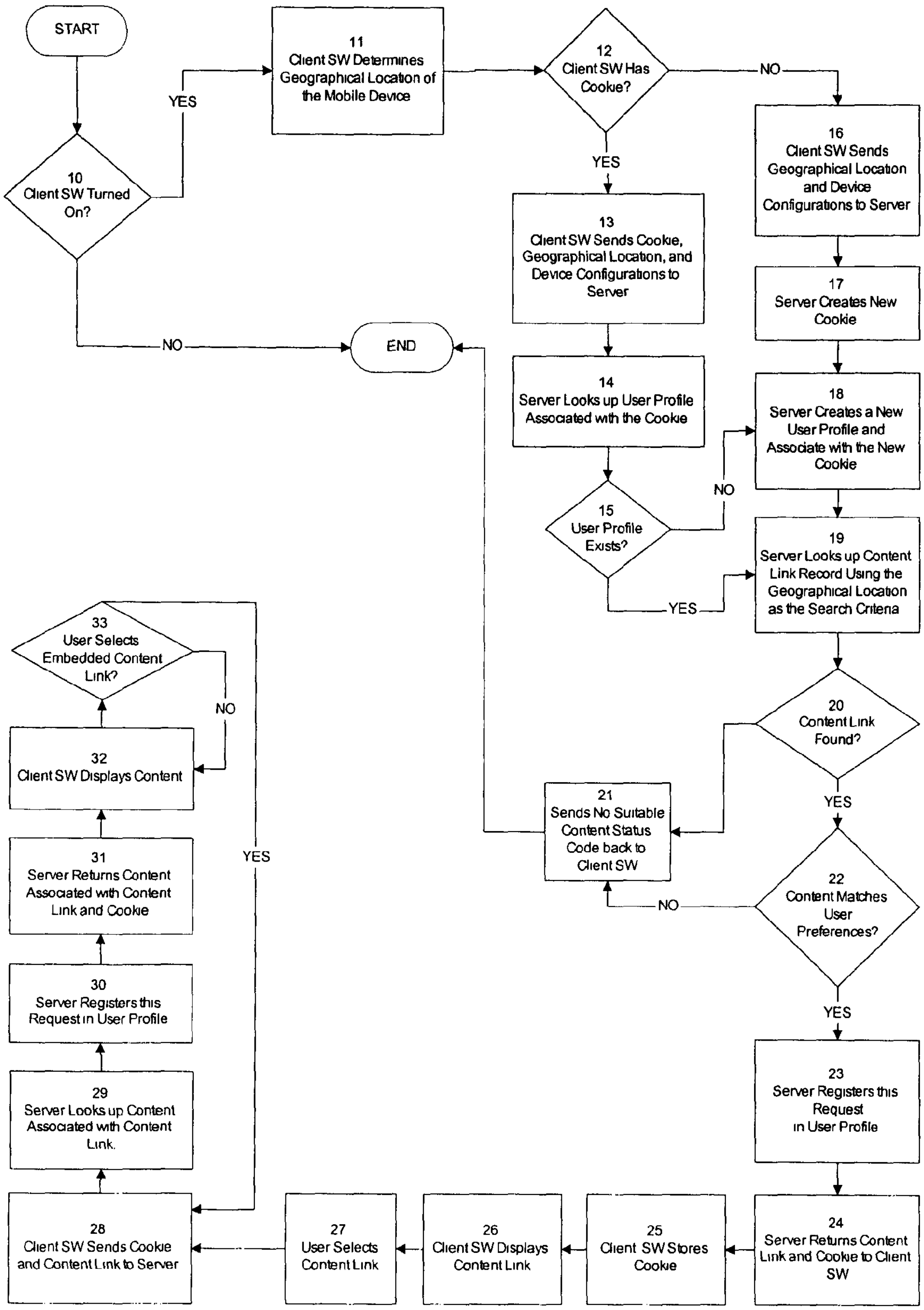
(54) Abstract Title: **Providing location based information to a mobile device**

(57) A mobile device such as a personal digital assistant (PDA) or mobile phone obtains its geographic location, using for example a global positioning system (GPS), and provides the location to a sever, preferably through a wireless connection. The server hosts a database containing information associated with geographical location, and provides relevant information links to the mobile device based on the location of the device. The user of the device may use the links to obtain further information associated with the user's vicinity, e.g. further information relating to advertising billboards, or nearby restaurants, museums, cinemas, weather and traffic reports etc. The database may also include user profile information including user preferences. The mobile device may provide the server with information describing its properties so that the server can provide the information in a correct format for display on the device.

GB 2 407 230 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

FIG. 1


START
10
Client SW Turned On?
YES
NO
11
Client SW Determines Geographical Location of the Mobile Device
12
Client SW Has Cookie?
YES
NO
13
Client SW Sends Cookie, Geographical Location, and Device Configurations to Server
14
Server Looks up User Profile Associated with the Cookie
15
User Profile Exists?
NO
YES
16
Client SW Sends Geographical Location and Device Configurations to Server
17
Server Creates New Cookie
18
Server Creates a New User Profile and Associate with the New Cookie
19
Server Looks up Content Link Record Using the Geographical Location as the Search Criteria
20
Content Link Found?
YES
21
Sends No Suitable Content Status Code back to Client SW
END
22
Content Matches User Preferences?
NO
YES
23
Server Registers this Request in User Profile
24
Server Returns Content Link and Cookie to Client SW
25
Client SW Stores Cookie
26
Client SW Displays Content Link
27
User Selects Content Link
28
Client SW Sends Cookie and Content Link to Server
29
Server Looks up Content Associated with Content Link.
30
Server Registers this Request in User Profile
31
Server Returns Content Associated with Content Link and Cookie
32
Client SW Displays Content
33
User Selects Embedded Content Link?
NO
YES

2407230

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SYSTEM FOR PROVIDING ACCESS TO INFORMATION

This invention relates to a system, method and apparatus for providing access to information. In particular, though not exclusively, the present invention relates to a system that enables a user to obtain customized and updated current information from a variety of sources that may be related to visual displays in a user's vicinity.

It is extremely well-known to provide information to the public through fixed media such as advertising billboards, posters, bus and train timetables and the like. The information that can be provided in this manner is however limited in a number of ways. The information is limited, for example, by the space available on the billboard or the like. The information can only be updated by physically replacing the billboard or the like. Furthermore the information that is provided must be information of common interest to multiple users and it is not generally possible to tailor the information for the needs and interests of different users.

More recently such traditional methods of transmitting information have been enhanced by incorporating video displays that may include moving images and sound. Video displays allow the more sophisticated presentation of information and may also provide for a degree of interaction between the display and a user (for example through the use of touchscreen technologies). However, such units are comparatively expensive and do not solve the problem that the information presented cannot easily be updated in realtime, and while interactivity is possible to a degree, it is still not possible to easily customise the information for a particular user.

It will also be understood that enormous amounts of data and information are available on computer databases that can be accessed. Such databases can be accessed, for example, through either wired or wireless connections, through the Internet, or through direct dial-up connections. Such databases must, however, be accessed directly by a user who must

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know the location of the databases by, for example, knowing a website address or by using a search engine to find an address.

It is an object of the present invention therefore, at least in preferred forms, to provides an apparatus and method that allows a user to obtain current realtime information and data that may be customized to a user's interests and needs that overcomes the drawbacks in the prior art or that at least provides a commercially useful alternative.

GB 0313774.2 (the contents of are hereby incorporated by reference) provides a system for providing a user with access to information in which transmitter means are provided for transmitting a signal including a unique code. A server hosts a database including information associated with these unique code, including an indication of the subject matter associated with each code. In this system a mobile device receives the signal and sends the unique code to the server and, upon receipt of the unique code from the mobile device, the server provides to the mobile device the information of the subject matter associated with the code and upon a user request the server provides further information to the mobile device.

The present application discloses an alternative approach to the system of application 0313774.2 in which instead of transmitters, the location of the mobile device is determined directly, for example using GPS or triangulation techniques.

According to the present invention there is provided a system for providing a user with access to information, comprising: a server hosting a database including information concerning a plurality of outdoor media objects including their location and a link from which further information can be provided; and a mobile device including means for directly obtaining its location at any given time; wherein said mobile device provides its location to said server, and wherein in response said server compares the location of said device with the location of outdoor media objects in its database, and said server provides to said mobile device links whereby a user of said device may obtain further information concerning outdoor media objects in the user's vicinity.

Viewed from another broad aspect the present invention provides A system for providing a user with access to information, comprising: a server hosting a database including information that is associated with a location and including links from which further information can be provided; and a mobile device including means for providing location-based data to said server, and wherein in response said server provides to said mobile device links whereby a user of said device may obtain further information associated with the user's vicinity.

An embodiment of the invention will now be described by way of example and with reference to the accompanying drawings, in which:-

Fig.1 is a flowchart illustrating the method of a first embodiment of the invention.

In this specification a number of terms will be used which will be defined in advance:

"Mobile computing device" means any device that can be carried by a user and has computer processing capabilities. Examples in particular include personal digital assistants, laptop computers and some mobile phones.

"Outdoor media object" means and object that is intended to provide information to a viewer, and may in particular include an advertisement (either a billboard or a video display) but could also be other forms of information such as timetables, schedules, news, or weather information. The term "outdoor" is intended to refer to the placing of such objects in public areas which could included enclosed areas such as shopping malls.

"Location data" means any data that directly or indirectly provides the location of a mobile device.

United Kingdom patent application 0313774.2 (the contents of which are incorporated herein by reference) describes a system by which a user carrying a mobile computing device (such as a personal digital assistant (PDA) or a mobile phone) is able to interact with outdoor media objects such as advertisements in order to obtain more information regarding the products or services being advertised. In particular, each billboard may be provided with a transmitter (for example a transmitter using the Bluetooth protocol) that transmits a code unique to that billboard. If the user is carrying a Bluetooth enabled mobile device such as a PDA or mobile phone, then the user is able to receive that code from the transmitter. If the user wishes to receive further information regarding the products or services being advertised, then the user will use his/her mobile device to send the unique code to a server to obtain further information regarding the products or services.

An embodiment of the present invention will now be described with reference to Fig.1. In step 10 the software running on the client mobile device must, of course, be running. If not the method simply comes to an end. Assuming that the software is running, the first step (step 10) is that the software determines the location of the mobile device using any known form of position determining means such as various forms of satellite positioning systems such as the known GPS method, or by triangulation techniques based upon the location of nearby wireless transmitters. Such position determining means are known in the art and do not need to be described in detail.

In this embodiment the software running on the mobile device determines the location of the mobile device using such known GPS/triangulation techniques. Once the location of the mobile device has been found, that location data may be sent to a server. If the user has a cookie stored on the mobile device, then that cookie is also transmitted, and if not a cookie is generated. As will be described below the server contains a database of advertisements or the like and their locations. Thus, the server will know that if a user is at a certain location, then he/she is close to a particular billboard and the server will transmit to the user a content link that enables the user to obtain more information regarding the product or services being advertised if he/she wishes.

The cookie will identify the user to the server, and the server will store a user profile. This may be used to ensure that the user is sent content links only in respect of products or services of interest to that particular user.

Returning to Fig.1, when the mobile device has sent its geographical location to the server with a cookie identifying the user (or if no such cookies exists, then one will be created), the server searches its database to find any content links that relate to that location. If such content links are found, they are sent back to the mobile device provided they match any pre-stored user preferences, and together with any cookie if that has been freshly created. If no suitable content links are found corresponding to that location (taking into account any prestored user preferences) then a suitable message will be sent. Once a user receives any content links, then the user can decide whether or not to request further information by responding to the content links (steps 30 to 37).

It will be understood that the embodiment described in Fig.1 provides an alternative to the method described in 0313774.2 for enabling a user to obtain more information (if desired) on an advertised product or service. The difference is that while in application 0313774.2 a user receives a unique code directly from a transmitter associated with (for example) a billboard, in the embodiment of Fig.1 the user provides to the server location data obtained through GPS/triangulation techniques, and the server sends back possible content links that relate to advertising billboards in the users vicinity. Indeed, in the embodiment described above there need not necessarily be any form of outdoor media object or advertisement at all, instead links may be provided to a mobile that enable a user to obtain more information of any nature that is pertinent to the user's current location. This could include links to details of nearby restaurants, museums, cinemas or so on, weather and traffic reports.

By using cookies personal preferences of users may be stored by the server so that the user is only provided with information of potential interest to that user. This is described further in 0313774.2. In addition, when the mobile device provides the location data to the server, it may also provide information regarding the nature of the mobile device, its display and operating systems, so that the links and further information are provided to the mobile device in a format that is suitable for that device.

CLAIMS

1. A system for providing a user with access to information, comprising: a server hosting a database including information concerning a plurality of outdoor media objects including their location and a link from which further information can be provided; and a mobile device including means for directly obtaining its location at any given time; wherein said mobile device provides its location to said server, and wherein in response said server compares the location of said device with the location of outdoor media objects in its database, and said server provides to said mobile device links whereby a user of said device may obtain further information concerning outdoor media objects in the user's vicinity.

2. A system as claimed in claim 1 wherein said mobile devices communicate with said server through a wireless connection.

3. A system as claimed in claim 1 wherein said mobile device provides to said server information describing the properties of said mobile device whereby said server can provide information to said mobile device in a correct format for display on said mobile device.

4. A system as claimed in claim 1 wherein said database includes user profile information.

5. A system as claimed in claim 4 wherein said user profile information includes user preferences that may be selected by a user.

6. A system for providing a user with access to information, comprising: a server hosting a database including information that is associated with a location and including links from which further information can be provided; and a mobile device including means for providing location-based data to said server, and wherein in response said server provides to said mobile device links whereby a user of said device may obtain further information associated with the user's vicinity.

7. A system as claimed in claim 6 wherein said information associated with a location comprises information associated with an outdoor media object provided at said location.

8. A system as claimed in claim 6 wherein said mobile devices communicate with said server through a wireless connection.

9. A system as claimed in claim 6 wherein said mobile device provides to said server information describing the properties of said mobile device whereby said server can provide information to said mobile device in a correct format for display on said mobile device.

10. A system as claimed in claim 6 wherein said database includes user profile information.

11. A system as claimed in claim 10 wherein said user profile information includes user preferences that may be selected by a user.

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Application No:	GB0322026.6	**Examiner:**	Matthew Nelson
Claims searched:	1-11	**Date of search:**	9 February 2005

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X,Y	X: 1, 2, 4-8, 10, 11; Y: 3, 9	GB 2356321 A (HUGH SYMONS GROUP) See e.g. p. 14, lines 3-13; p. 15, lines 9-24; p. 17, lines 15-29 and p. 26, line 16 - p. 27, line 30.
X,Y	X: 1, 2, 4-8, 10, 11; Y: 3, 9	WO 02/102025 A1 (AT & T) See e.g. the abstract.
X,Y	X: 1, 2, 4-8, 10, 11; Y: 3, 9	WO 02/093290 A2 (NOKIA) See whole document.
X,Y	X: 1, 2, 4-8, 10, 11; Y: 3, 9	WO 00/49530 A1 (PARASNIS et al) See e.g. the abstract; p 14, line 10 - p. 15, line 33 and p. 20, lines 15-17.
X,Y	X: 1, 2, 4-8, 10, 11; Y: 3, 9	US 2003/0008661 A1 (JOYCE et al) See e.g. paragraphs [0021]-[0030] and [0045]-[0048].
X,Y	X: 1, 2, 4-8, 10, 11; Y: 3, 9	US 2002/0022488 A1 (SRINIVASAN et al) See e.g. the abstract and paragraphs [0053]-[0055].
Y	3, 9	WO 02/35798 A1 (NOKIA) See p. 6, lines 3-22.
Y	3, 9	WO 00/44119 A1 (FUNG et al) See e.g. figure 1 and p. 12, line 25 - p. 13, line 13.
Y	3, 9	WO 00/14640 A1 (SONY) See the abstract.

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Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

H4L

Worldwide search of patent documents classified in the following areas of the IPC^{07}

G06F; H04Q

The following online and other databases have been used in the preparation of this search report

Online: WPI, EPODOC

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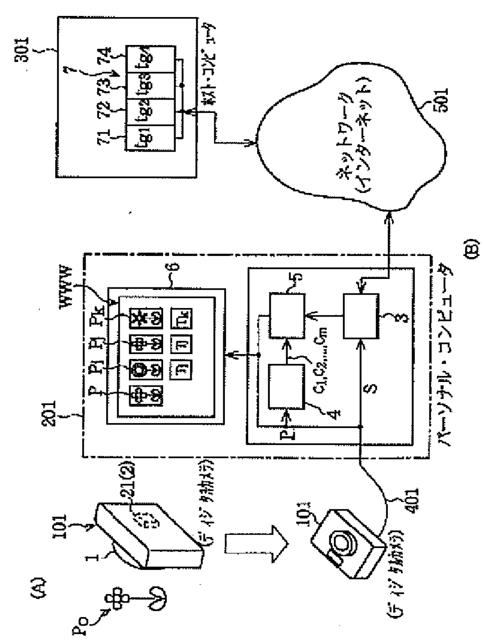
(54)【発明の名称】　写真画像検索システム

(57)【要約】

【課題】　ディジタルカメラ等から、動植物等の検索対象画像を取り込み、これに類似する画像を、多数のデータベース画像から素早く検索しその説明分をディスプレイに表示する。

【解決手段】　データベース画像およびその説明文からなり、フィールド中に画像特徴属性を含み、かつ、撮影状況属性に応じてデータベーズ画像が分類されているデータデータベース７と、検索対象画像の取込み手段１と、撮影状況特定手段２と、撮影状況の情報に基づき、データベース画像の検索範囲の絞り込みを行う検索範囲絞り込み手段３と、検索対象画像の画像特徴を特定する抽出手段４と、検索対象画像に類似するデータベース画像を、候補画像として抽出する対象画像検索手段５と、候補画像Ｐ$_i$，Ｐ$_j$，Ｐ$_k$ を表示すると共に、その説明文Ｔ$_i$，Ｔ$_j$，Ｔ$_k$ を表示するディスプレイ６と、を含むことを特徴とする。



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【特許請求の範囲】

【請求項１】　多数のデータベース画像およびこれらデータベース画像の説明文からなり、フィールド中に画像特徴属性を含み、かつ、撮影状況属性に応じたタグを持つ複数のデータベース要素に分割されたデータベースと、
検索対象画像を取り込むための画像取込み手段と、
前記検索対象画像の撮影状況を、自動検出により特定する撮影状況特定手段と、
前記撮影状況特定手段により特定された撮影状況の情報に基づき、前記タグを参照して、前記データベース要素を特定することで、前記データベース画像の検索範囲の絞り込みを行う検索範囲絞り込み手段と、
前記検索対象画像の画像特徴を特定する画像特徴抽出手段と、
前記画像特徴抽出手段により特定された画像特徴に基づき、前記検索範囲絞り込み手段により絞り込まれた検索範囲内で、前記検索対象画像に類似するデータベース画像を、候補画像として抽出する対象画像検索手段と、
前記候補画像を表示すると共に、当該候補画像に付随する前記説明文を表示するディスプレイと、を含むことを特徴とする写真画像検索システム。

【請求項２】　多数のデータベース画像およびこれらデータベース画像の説明文からなり、フィールド中に画像特徴属性および撮影状況属性を含むデータベースと、
検索対象画像を取り込むための画像取込み手段と、
前記検索対象画像の撮影状況を、自動検出により特定する撮影状況特定手段と、
前記撮影状況特定手段により特定された撮影状況の情報に基づき、前記撮影状況属性を参照して、前記データベース画像の検索範囲の絞り込みを行う検索範囲絞り込み手段と、
前記検索対象画像の画像特徴を特定する画像特徴抽出手段と、
前記画像特徴抽出手段により特定された画像特徴に基づき、前記検索範囲絞り込み手段により絞り込まれた検索範囲内で、前記検索対象画像に類似するデータベース画像を、候補画像として抽出する対象画像検索手段と、
当該候補画像を表示すると共に、当該候補画像に付随する前記説明文を表示するディスプレイと、を含むことを特徴とする写真画像検索システム。

【請求項３】　請求項１または２に記載の写真画像検索システムにおいて、
前記撮影状況属性が年を周期とする時属性であり、
前記検索範囲絞り込み手段は、付属の時計により特定された撮影時情報により、前記データベース画像の検索範囲の絞り込みを行う、ことを特徴とする写真画像検索システム。

【請求項４】　請求項３に記載の写真画像検索システムであって、

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前記画像取込み手段と、前記ディスプレイと、前記時計とが一体となって、または前記画像取込み手段と、前記自動位置検出機構とが一体となって、携帯機器を構成してなることを特徴とする写真画像検索システム。

【請求項５】　請求項１または２に記載の写真画像検索システムにおいて、
前記撮影状況属性が画像の存在場所を示す場所属性であり、
前記検索範囲絞り込み手段は、付属の自動位置検出機構により特定された撮影場所の情報により、前記データベース画像の検索範囲の絞り込みを行う、ことを特徴とする写真画像検索システム。

【請求項６】　請求項５に記載の写真画像検索システムであって、
前記画像取込み手段と、前記ディスプレイと、前記自動位置検出機構とが一体となって、または前記画像取込み手段と、前記自動位置検出機構とが一体となって、携帯機器を構成してなることを特徴とする写真画像検索システム。

【請求項７】　請求項１～６に記載の写真画像検索システムであって、
前記ディスプレイに、前記候補画像および当該候補画像に付随する前記説明文に加え、検索対象画像を表示することを特徴とする写真画像検索システム。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、ディジタルカメラ等から、動植物、自然物、建造物等の検索対象画像を取り込み、この検索対象画像に類似する画像を、多数のデータベース画像から素早く検索し、その説明分を表示できる写真画像検索システムに関する。

【０００２】

【技術背景】写真のデータベースとして、従来、コンテントーベースド・イメージ・リトリーバル・システム（Ｃｏｎｔｅｎｔ－ｂａｓｅｄ　Ｉｍａｇｅ　Ｒｅｔｒｉｅｖａｌ　Ｓｙｓｔｅｍ）が知られている。このシステムでは、ユーザが、検索対象写真の特徴を、入力することにより、当該検索対象写真を検索する。検索対象写真の特徴として、たとえば、全体の色調、使われている色の統計（ヒストグラム）、隣接する色の組合せパターン、被写体の輪郭等、様々なものがある。このシステムでは、目的とする写真を、多数のデータベース写真から抽出するために、検索対象の色や輪郭等の特徴をデータベースに入力しなければならない。このため、希望する写真を入手することは、熟練を要し、一般にユーザにとっては容易でない。

【０００３】これに対し、前記特徴を文字で入力する代わりに、写真そのものを検索対象として用いるクィアリー・バイ・イグザンプル（Ｑｕｅｒｙ　ｂｙ　Ｅｘａｍｐｌｅ）による方法も知られている。この方法では、検

索対象としての写真を１枚用意し、当該検索対象写真に類似した写真をデータベースから抽出する。通常、この類似性は、前述した写真全体の色調、ヒストグラム、隣接する色の組合せパターン、被写体の輪郭等の評価関数によって定められる。

【０００４】上記のような写真のデータベース・システムでは、データベースを構築するに際して、全体のピクセルをスキャンし、特徴となるべきデータ構造を予め作成しておく。そして、これらをキーとしてデータベース・システムに登録しておき、検索に用い、検索対象画像に似ている写真（１つとは限らない）を候補画像として抽出する。ここでの検索は、データベース写真の特徴と、検索対象写真の特徴とを、何らかの評価関数により比較し、両者の差が所定のしきい値よりも小さければ「的中」とし、そうでなければ「不的中」とする。この特徴の比較は、原則的にはデータベース写真の全てについて行う必要がある。

【０００５】写真（画像）の特徴を示すデータ構造は、一般に複雑であり、検索対象写真とデータベース写真との比較に要する計算量は膨大となる。このため、上記のような写真のデータベースでは、文字列や数値の比較を行うデータベースに比べて、検索に膨大な時間を要すると言った不都合がある。

【０００６】この不都合を解消するために、写真の特徴データの比較を行う前に、他の情報により検索範囲を限定することが有効である。例えは、フォト・エンサイクロペディア・システムの場合には、植物、鳥類、魚類などのカテゴリーごとにデータベースを分けておき、検索の際にユーザに上記カテゴリーを指定させ、検索範囲を限定させる。この場合、さらに、検索範囲を限定するために、サブカテゴリーを定義しておき、ユーザに、撮影時（月，季節等）や撮影場所を指定させることも考えられる。しかし、ユーザが検索を行うことができるのは、撮影から長時間が経過している場合も多く、検索の際には撮影時や撮影場所についての記憶が不明確となり、正確にこれらを特定することができないと言った問題がある。

【０００７】

【発明の目的】本発明の目的は、ディジタルカメラ等から取り込んだ検索対象画像と類似または同一の画像を、撮影状況（たとえば、時、場所）に応じて、多数のデータベース画像から素早く検索し、その説明文を表示することができる写真画像検索システムを提供することである。また、本発明の他の目的は、写真画像検索システムにより、撮影から長時間が経過していても撮影時の状況をユーザの記憶によらずに特定でき、あるいは撮影後、直ちに撮影場所において検索を行うことができる、実質上、フォト・エンサイクロペディアの機能を持つディジタルカメラを提供することである。

【０００８】

【発明の概要】本発明のシステムでは、データベースは、多数のデータベス画像およびその説明文からなり、当該データベース画像の検索用のフィールドには、画像特徴属性が含まれる。

【０００９】データベースは、通常、ハードディスク、ＣＤ－ＲＯＭ等の大容量記憶媒体に格納される。データベース画像は、通常、デジタイズされた写真であり、画像全体がビットマップとして表現されるものであってもよいし、輪郭等がベクトルとして表現されるものであってもよい。データベース画像の説明文は、通常、文字コードの形態で、データベース画像と関連させて格納されるが、説明文中に画像を含むこともある。画像特徴属性は、写真全体の色調、ヒストグラム、隣接する色の組合せパターン、被写体の輪郭等である。

【００１０】本発明のシステムでは、データベース画像を撮影状況属性により分類しておき、検索対象画像の撮影状況に応じて、検索範囲を絞り込む２つの手法（これらの手法については後述する）を導入することにより、素早い検索が可能となる。１番目の手法を用いる場合には、データベースは、それぞれ撮影状況属性に応じたタグを持つ複数のデータベース要素に分割される。以下、１番目の手法を用いる本発明のシステムを、第１システムと言う。２番目の手法を用いる場合には、データベースのフィールドには前述した画像特徴属性の他、撮影状況属性が含まれる。以下、２番目の手法を用いる本発明のシステムを、第２システムと言う。

【００１１】本発明のシステムは、上記データベースの他、画像取込み手段と、撮影状況特定手段と、検索範囲絞り込み手段と、画像特徴抽出手段と、対象画像検索手段と、ディスプレイとを含む。

【００１２】画像取込み手段は、たとえばディジタルカメラの撮影機能部分であり、検索対象画像を取り込む。なお、ディジタルカメラは、後述するように、画像取込み手段、撮影状況特定手段、ディスプレイと一体に構成されることもある。

【００１３】撮影状況特定手段は、前記検索対象画像の撮影状況（たとえば、撮影時や撮影場所）を、ユーザの設定により、または自動検出により特定する。ここで、撮影状況属性は、たとえば、時属性または／および場所属性である。時属性は、たとえばデータベース画像の被写体が花である場合には、当該花の開花時期（月や季節）であり、場所属性は、たとえば、データベース画像の被写体が建造物や自然物である場合には、これらの所在地でる。また、撮影状況特定手段は、撮影状況、たとえば検索対象画像の撮影時または／および撮影場所、を特定する。この特定は、ユーザの設定（適宜のインターフェースにより行われる）により行われることもあるし、システムに付属の時計または／および自動位置検出装置により行われる。なお、自動位置検出装置は、たとえば、ＧＰＳ（Ｇｌｏｂａｌ　Ｐｏｓｉｔｉｏｎｉｎｇ

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Ｓｙｓｔｅｍ）の端末機器、あるいは移動電話所持者の所在地域を基地局の所在位置により特定するシステムの当該移動電話である。

【００１４】検索範囲絞り込み手段は、第１システムでは、前記撮影状況特定手段により特定された撮影状況の情報に基づき、前記タグを参照して、前記データベース要素を特定することで、前記データベース画像の検索範囲の絞り込みを行う。また、検索範囲絞り込み手段は、第２システムでは、前記撮影状況特定手段により特定された撮影状況の情報に基づき、前記撮影状況属性を参照して、前記データベース画像の検索範囲の絞り込みを行う。

【００１５】画像特徴抽出手段は、前記検索対象画像の画像特徴を特定する。対象画像検索手段は、前記画像特徴抽出手段により特定された画像特徴に基づき、前記検索範囲絞り込み手段により絞り込まれた検索範囲内で、前記検索対象画像に類似するデータベース画像を、候補画像として抽出する。これら、画像特徴抽出手段と対象画像検索手段とは、前述した従来公知のクィアリー・バイ・イクザンプルによる処理を行う。この処理は、本発明のシステムに搭載された、１つまたは複数のプロセッサにより、ハードウェア的またはソフトウェア的に行われる。

【００１６】ディスプレイは、当該候補画像を表示すると共に、当該候補画像に付随する前記説明文を表示する。このディプレイは、たとえば、画像取込み手段と一体に構成した液晶ディスプレイであってもよいし、画像取込み手段とは別体に構成した液晶または陰極管ディスプレイであってもよい。この場合、ディスプレイには、候補画像および説明文に加え、検索対象画像を表示することが好ましい。

【００１７】本発明のシステムでは、第１システムと第２システムとにより１つのシステムを構成し、データベースの検索の際に、１番目の手法と２番目の手法とによる検索範囲の絞り込みを併用することもできる。

【００１８】本発明のシステムにおいては、全ての構成要素を一体に構成してもよいし、システムを所定の構成要素からなる複数の部分に分割してもよい。たとえば、システムを、データベース、検索範囲絞り込み手段および対象画像検索手段を含むシステム本体と、画像取込み手段、撮影状況特定手段およびディスプレイを含む携帯機器との２つの部分により構成することができる。また、たとえば、システムを、データベース、検索範囲絞り込み手段、ディプレイおよび対象画像検索手段を含むシステム本体と、画像取込み手段および撮影状況特定手段（時計や自動位置検出機構）を含む携帯機器との２つの部分により構成することができる。また、インターネット等のネットワークシステムに本発明のシステムを応用する場合には、上記システム本体の一部の構成要素（ただし、ディスプレイおよび検索範囲絞り込み手段を除く）を、ホスト局やサイトに設けることもできる。この場合には、ユーザは、ＷＷＷ（Ｗｏｒｌｄ　Ｗｉｄｅ　Ｗｅｂ）等におけるインターフェースを介して、検索作業を行うことができる。

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【００１９】本発明のシステムを、システム本体と携帯機器とから構成する場合には、通常、携帯機器は、検索対象画像を、時または／および場所の情報と共に、通信回線を介してシステム本体に送信する。システム本体は、検索範囲の絞り込みおよび当該検索対象画像についての検索を行い、その候補画像を上記通信回線を介して携帯機器に送信する。そして、候補画像やそれに付随する説明文が、ディスプレイに表示される。なお、システム本体と携帯機器とから構成する場合において、携帯機器からシステム本体に検索対象画像等を送るために、画像記録媒体（合成樹脂フィルムを用いたカメラにおける、当該フィルムに相当する）を、ユーザが手操作で携帯機器から抜き取り、システム本体の所定の画像記録媒体読み取り装置に挿着することもできる。

【００２０】本発明のシステムにおいては、特に、全ての構成要素同士を一体に構成する場合や、携帯機器とシステム本体とを無線の通信回線を介して接続する場合には、本発明のシステムは、実質上、フォト・エンサイクロペディアの機能を持つディジタルカメラである。このようなシステムでは、撮影直後、即座に（撮影場所にて）検察を開始することができる。なお、携帯機器とシステム本体とを無線を介して接続する場合に、ユーザは検索操作をしたり候補画像を見る必要がある。したがって、この場合には、携帯機器には、通常、ディスプレイを含むことが必要となる。

【００２１】また、本発明のシステムでは、撮影時に、撮影状況を所定の記憶装置に自動書込みしておき、撮影後、撮影場所とは異なる場所で検索を行うこともできる。この場合には、システムを、全ての構成要素同士を一体となるように構成してもよいし、システム本体と携帯機器とから構成してもよい。撮影後、撮影場所とは異なる場所で検索を行う必要が生じるのは、典型的には、システムをシステム本体と携帯機器とから構成し、かつ携帯機器とシステム本体とを有線の通信回線を介して接続する場合であろう。

【００２２】なお、本発明のシステムでは、撮影画像に説明文を付属させて、当該撮影画像を保存し、またはプリンタ等に出力することができる。

【００２３】本発明のシステムは、データベースに、大容量記憶装置を使用できるので、膨大な量の、動植物、建造物、自然物についての写真データをその説明文と共にデータベース化できる。ユーザが画像取込み装置で撮影した、たとえば草花，果実等の検索に際しては、その開花時期や結実時期（撮影時期）や、その生息地域（撮影場所）に応じた検索範囲の絞り込みが、自動的に行われる。したがって、検索対象画像とデータベース画像と

の色の組合せやヒストグラムを基にした特徴比較に要する時間は極めて短かい。また、水中カメラで魚類を撮影する場合にも、本発明のシステム（後述する実施例３で説明するような、カメラ一体形のフォト・エンサイクロペディア・システム）を用いれば、ＧＰＳにより撮影場所の情報（すなわち、魚類等の生息域の情報）が得られるので、検索範囲の絞り込みが行われ、水中でのデータ検索も即座に行われる。なお、この場合、ＧＰＳによる場所特定を潜水前に行う必要がある。さらに、たとえば、植物園、動物園、水族館等の施設に、データベースが書き込まれた、メモリカード，ＣＤ－ＲＯＭ等の記憶媒体を用意しておき、施設の利用者にこの記憶媒体を貸与することもできる。この場合には、草花、動物、魚等のデータベース画像の検索用フィールドには施設内の場所を書き込んでおく。そして、これら施設におけるユーザの場所を適宜の自動位置検出により特定することで、ユーザが撮影した被写体の説明文を、カメラに表示することができる。本発明のシステムを、建造物、記念碑、あるいは自然物のフォト・エンサイクロペディア・システムとして使用する場合には、ＧＰＳ等の自動位置検出装置により、撮影場所を特定することができる。したがって、撮影場所（京都、奈良、鎌倉等）についての検索範囲の絞り込みができる

【００２４】

【実施例】以下、本発明のシステムを、フォト・エンサイクロペディア・システムとして使用する場合の実施例を詳細に説明する。

【００２５】〔実施例１〕本発明の第１システムの実施例を説明する。後述するように（実施例３参照）、本発明のシステムでは、各構成要素を一体に構成することもできるが、実施例１においては、システムを複数の部分に分割している。すなわち、実施例１では、システム全体は、ディジタルカメラ１０１と、パーソナル・コンピュータ２０１と、ホスト・コンピュータ３０１とからなり、図１に示すように、ディジタルカメラ１０１はパーソナル・コンピュータ２０１に、通信回線４０１を介して接続されている。さらに、パーソナル・コンピュータ２０１は、ネットワーク５０１を介して、ホスト・コンピュータ３０１に接続されている。なお、本実施例では、ネットワーク５０１は、インターネットであり、ユーザはＷＷＷのユーザインターフェースを介して、ホスト・コンピュータ３０１のデータベースを利用できる。

【００２６】ここでは、ディジタルカメラ１０１は、画像取込み手段１と、撮影状況特定手段２（図１では、時計２１）とを有している。また、パーソナル・コンピュータ２０１は、検索範囲絞り込み手段３と、画像特徴抽出手段４と、対象画像検索手段５、ディスプレイ６とにより構成されている。データベース７は、ホスト・コンピュータ３０１の大容量記憶媒体（ここでは、ハードディスク）に書き込まれている。実施例１では、図２にも示すように、データベース７は複数のデータベース要素（ここでは７１～７４の４つ）に分割され、各データベース要素には、時属性に応じたタグ（図２では、春夏秋冬の四季に対応するタグ tg_1 ～ tg_4 ）が付されている。なお、ここでは、検索範囲絞り込み手段３、画像特徴抽出手段４および対象画像検索手段５の機能は、パーソナル・コンピュータ２０１が持つ演算処理装置により達成されるが、これらの機能の全てまたは一部を、ホスト・コンピュータ３０１に負担させる（すなわち、検索範囲絞り込み手段３、画像特徴抽出手段４および対象画像検索手段５をホスト・コンピュータ３０１に設ける）こともできる。

【００２７】実施例１（図１）のシステムにおけるデータベース７の構築手法について説明する。ここでは、この構築作業は、ホスト・コンピュータ３０１側で行われる。まず、データベース７に取り込む写真画像 P_x と、その説明文 T_x とを、ハイパーテキストの形態で、データベース構築システムに取り込む。そして、当該システムの特徴抽出プログラムＡを用いて、写真画像 P_x をスキャンし、画像特徴 C_1 （ｘ），C_2 （ｘ），・・・，C_m （ｘ）を抽出し、これをインデックス I_x の所定フィールドに書き込む。写真画像 P_x 、その説明文 T_x およびインデックス I_x を、写真画像 P_x の時属性（ここでは、写真画像 P_x がどの季節に属するか）に応じて、対応するタグ tg_1 ～ tg_4 を持つデータベース要素７１～７４の何れかに登録する。なお、上記インデックス I_x の所定フィールドには、説明文 T_x のＵＲＬ（Ｕｎｉｆｏｒｍ　Ｒｅｓｏｕｒｃｅ　Ｌｏｃａｔｏｒ）を書き込む。このようにして作成されたデータベース７は、ホスト・コンピュータ３０１のハードディスクに書き込まれる。

【００２８】以下、図１および図２を参照して、実施例１のシステムの作用を説明する。図１（Ａ）に示すように、ユーザが画像取込み手段１により、上記カテゴリーに含まれる被写体（ここでは、植物）P_o を撮影すると、撮影状況特定手段２（時計２１）が撮影時（ここでは季節）を特定する。検索の際には、図１（Ｂ）に示すように、画像特徴抽出手段４が検索対象画像Ｐを取り込む。これと同時に、検索範囲絞り込み手段３は、撮影時の情報Ｓをディジタルカメラ１０１から取得する。検索範囲絞り込み手段３は、撮影時の季節に応じて、データベース要素７１～７４の何れかを選択する。なお、撮影時が季節の境目の月等に属するときには、検索範囲絞り込み手段３は、２つの季節を選択することもできる。一方、画像特徴抽出手段４は、検索対象画像Ｐをスキャンし、画像特徴 C_1 ，C_2 ，・・・，C_m を抽出する。

【００２９】ここで、ネットワーク５０１を介してホスト・コンピュータ３０１の、検索範囲絞り込み手段３により選択されたデータベースへのアクセスが行われる。

対象画像検索手段５は、画像特徴抽出手段４により抽出された検索対象画像Ｐの画像特徴C_1，C_2，・・・，C_mを、上記の選択されたデータベース要素のデータベース画像の画像特徴C_1（ｘ），C_2（ｘ），・・・，C_m（ｘ）と順次比較比較する。

【００３０】そして、検索対象画像Ｐに類似するデータベース画像（ここでは、候補画像P_i，P_j，P_k）を、ホスト・コンピュータ３０１のデータベース７からダウンロードし、検索対象画像Ｐと共に、ディスプレイ６に表示する。検索対象画像Ｐとデータベース画像との類似の判断には、従来公知の適当な手法（たとえば、評価関数を用いる方法）が適用される。ユーザは、適宜のユーザインターフェースを介して、候補画像P_i，P_j，P_kの何れかを指定する（たとえば、ディスプレイ６に表示されたカーソルにより候補画像の何れかを指定する）。説明文T_i，T_j，T_kは、適宜（たとえば、上記候補画像のダウンロードの際に、あるいはこれとは別個に）ダウンロードされ、ユーザは、候補画像P_i，P_j，P_kに対応する説明文T_i，T_j，T_kをディスプレイ６に表示することができる。なお、ディスプレイ６に同時に表示する画像は、検索対象画像Ｐと１つの候補画像のみとし、ユーザが候補画像を順次て切りかえ表示するようにもできる。

【００３１】実施例１では、データベース画像の時属性として季節を用い、データベース７を、４つのデータベース要素７１～７４に分割したが、本発明はこれに限定されず、データベース画像の時属性として、たとえば月を用い、データベース７をたとえば月数（１２個）のデータベース要素に分割することもできる。

【００３２】また、データベース画像の場所属性により、データベース７を適当な数に分類して分割することもできる。この場合には、撮影状況特定手段２は、自動位置検出部（たとえばＧＰＳの端末機能を有する）を含む。自動位置検出部の機能については、後述する実施例２で説明するので、ここでは説明は省略する。

【００３３】なお、図示はしないが、時属性に応じて分割されたデータベース要素のそれぞれを、さらに場所属性に応じて複数のデータベース要素に分割すること、逆に場所属性に応じて複数のデータベース要素に分割し、この分割されたデータベース要素のそれぞれを、さらに時属性に応じて複数のデータベース要素に分割することもできる。

【００３４】〔実施例２〕本発明の第２システムの実施例を説明する。実施例２は、撮影状況特定手段の構成が実施例１とは異なり、データベース構築の方法が実施例１とは異なっている。図３に示す実施例２のディジタルカメラ１０２，パーソナル・コンピュータ２０２，ホスト・コンピュータ３０２、通信回線４０２，およびネットワーク５０２が、実施例１のディジタルカメラ１０１，パーソナル・コンピュータ２０１，ホスト・コンピュータ３０１，通信回線４０１およびネットワーク５０１に対応する。ただし、実施例２のディジタルカメラ１０２の構成は、実施例１のディジタルカメラ１０１とはやや異なる。

【００３５】実施例２のディジタルカメラ１０２では、撮影状況特定手段２として、実施例１の時計２１に代えて自動位置検出部２２を用いている。この自動位置検出部２２は、静止衛生によるＧＰＳの端末機能を有しており、撮影場所の経度，緯度，標高を検出することができる。

【００３６】実施例２（図３）のシステムにおけるデータベースの構築手法について説明する。図４に示すように、まず、データベースに取り込む写真画像P_xと、その説明文T_xとを、ハイパーテキストの形態としてデータベース構築システムに取り込む。実施例２においても、実施例１と同様、データベース７に取り込む写真画像P_xとその説明文T_xとを、ハイパーテキストの形態でデータベース構築システムに取り込み、画像特徴C_1（ｘ），C_2（ｘ），・・・，C_m（ｘ）をインデックスI_xに書き込む。また、説明文T_xのＵＲＬが上記インデックスI_xに書き込まれる。なお、上記インデックスI_xには、場所を示すフィールドＦＬが含まれており、このフィールドには場所を示す情報が書き込まれる。インデックスI_xは、写真画像P_xおよびその説明文T_xと共に、データベース７に登録される。このようにして作成されたデータベース７は、ホスト・コンピュータ３０１のハードディスクに書き込まれる。

【００３７】以下、図３および図４を参照して、実施例２のシステムの作用を説明する。実施例２においても、図３（Ａ）に示すように、ユーザが画像取込み手段１により被写体（ここでは、建造物）P_0撮影をすると、撮影状況特定手段２（自動位置検出装置２２）が撮影場所を特定する。検索の際には、画像特徴抽出手段４が検索対象画像Ｐを取り込む。これと同時に、検索範囲絞り込み手段３は、撮影場所の情報Ｌをディジタルカメラ１０１から取得する。検索範囲絞り込み手段３は、ホスト・コンピュータ３０２のハードディスクに格納されているデータベースにアクセスし、上記場所情報Ｌが示す場所と、フィールドＦＬに書き込まれている場所情報Ｌとを比較して、データベース画像を選び出し、検索範囲の絞り込みを行う。一方、画像特徴抽出手段４は、検索対象画像Ｐをスキャンし、画像特徴C_1，C_2，・・・，C_mを抽出する。

【００３８】上記の検索範囲の絞り込みの方法は種々想定される。たとえば、フィールドＦＬには、当該フィールドに対応するデータベース画像の場所を、経度および緯度で記載しておく。場所情報Ｌが示す場所を中心とする所定半径の円内に、あるフィールドの経度および緯度が含まれ、かつ後述する標高条件を満たす場合に、そのフィールドに対応するデータベース画像を画像特徴抽出

の対象とする。また、たとえば、あるデータベース画像の場所が含まれる領域を多角形で表現し、この多角形の経度および緯度を、そのデータベース画像のフィールドに記載しておく。場所情報Ｌが示す場所がこの多角形に含まれかつ後述する標高条件を満たす場合に、そのデータベース画像を画像特徴抽出の対象とする。

【００３９】標高条件を満たすか否かの判断は、以下のように行う。たとえばフィールドに標高の上限と下限とを記載しておき、ある場所情報Ｌが示す場所の標高がその上限と下限との間に含まれる場合には、標高条件を満たしているものとし、そうでない場合には標高条件を満たさないものとする。なお、場所情報Ｌを、経度および緯度のみとし、場所情報Ｌには標高を含めないようにもできる。

【００４０】対象画像検索手段５は、画像特徴抽出手段４により抽出された検索対象画像Ｐの画像特徴C_1，C_2，・・・，C_mを、検索範囲の絞り込みが行われたデータベース画像の画像特徴C_1（ｘ），C_2（ｘ），・・・，C_m（ｘ）と順次比較する。

【００４１】実施例２では、実施例１と同様、対象画像検索手段５は、上記の絞り込まれた検索範囲に属するデータベース画像の中から、検索対象画像に類似するデータベース画像（ここでは、P_i，P_j，P_k）を候補画像として抽出し、ディスプレイ６には、ユーザが撮影してした写真Ｐと、この候補画像P_i，P_j，P_kを表示することができ、適宜説明文T_i，T_j，T_kも表示することができる。

【００４２】また、実施例２では、データベース画像の撮影状況属性として画像の存在場所を示す場所属性を用いたが、データベース画像の撮影状況属性として年を周期とする時属性を用いることもできる。この場合には、撮影状況特定手段２は時計である。データベースの構築に際し、インデックスには、撮影可能時期を示すフィールドを設け、このフィールドに、撮影が可能な時期（たとえば、月）の上限および下限を書き込んでおく。そして、時計から送られる時の情報が、フィールドの上記範囲に含まれるかを判断する。さらにインデックスに、年を周期とする属性（たとえは季節）を書き込むためのフィールドをそれぞれ設けておきことで、場所と季節とにより検索範囲を絞りこむこともできる。

【００４３】〔実施例３〕実施例３は、全ての構成要素が一体に構成されている点で、実施例１および２とは大きく構成が異なっている。図５に示す実施例３では、全ての構成要素は一体に、すなわち画像取込み手段１と、撮影状況特定手段２と、検索範囲絞り込み手段３と、画像抽出手段４と、対象画像検索手段５と、ディスプレイ６と、データベース７とは一体に構成されている。そして、システム全体が、携帯に適したフォト・エンサイクロペディアの機能を持つディジタルカメラを構成している。図５において、データベース７は、小形の光ディスク（MD）に書き込まれている。撮影状況特定手段２は、時計２１および／または自動位置検出部２２から構成することができ、実施例１または２において説明した撮影状況の特定を行うことができる。なお、図５のディスプレイ６には、被写体画像Ｐが表示された様子が示されているが、検索の際には図１（Ｂ）や図２（Ｂ）に示したように、ディスプレイ６には候補画像や説明文も表示される。

【００４４】また、実施例３では、実施例１または２において説明した、データベース７の構築手法の何れか一方または双方を採用することができ、これに応じた検索範囲の絞り込みを行うことができる。

【００４５】

【発明の効果】実質上、フォト・エンサイクロペディアの機能を持つディジタルカメラが実現される。特に、ユーザによる特別の操作なしに、ディジタルカメラ等から取り込んだ検索対象画像と類似または同一の画像を、撮影状況（たとえば、時、場所）に応じて、多数のデータベース画像から素早く検索し、被写体に関する説明文を得ることができる。

【図面の簡単な説明】

【図１】本発明の第１システムの一実施例を示すシステム構成図であり、データベースを撮影状況属性に応じて複数のデータベース要素に分割して検索範囲の絞り込みを行う場合を示している。

【図２】図１のシステムの作用を説明するための図である。

【図３】本発明の第２システムの一実施例を示すシステム構成図であり、撮影状況属性に応じたフィールドを設けることで検索範囲の絞り込みを行う場合を示している。

【図４】図３のシステムの作用を説明するための図である。

【図５】本発明のシステムの一実施例を示すシステム構成図であり、各構成要素が一体に構成されたフォト・エンサイクロペディアの機能を持つディジタルカメラを示す図である。

【符号の説明】

１　画像取込み手段
２　撮影状況特定手段
２１　時計
２２　自動位置検出手段
３　検索範囲絞り込み手段
４　画像特徴抽出手段
５　対象画像検索手段
６　ディスプレイ
７　データベース
７１～７４　　データベース要素
１０１，１０２　ディジタルカメラ
２０１，２０２　パーソナル・コンピュータ

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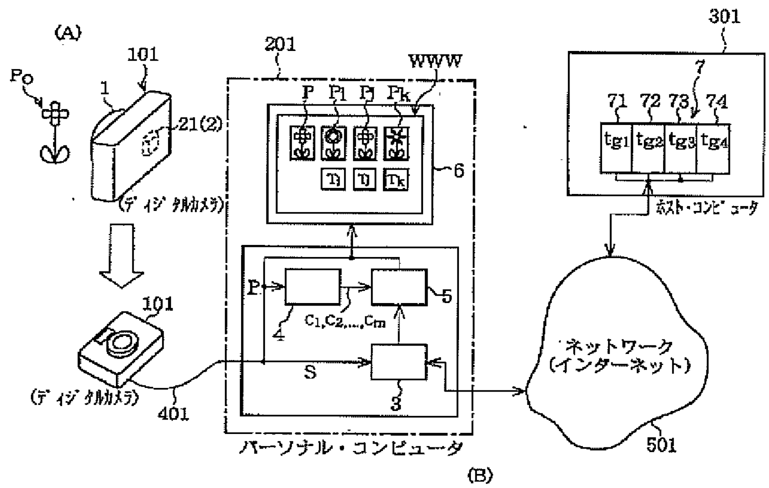
３０１，３０２　ホスト・コンピュータ
４０１，４０２　通信回線

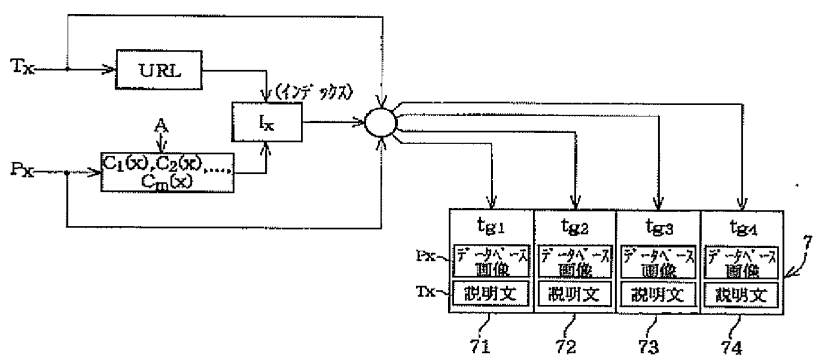
14

＊５０１，５０２　ネットワーク
＊

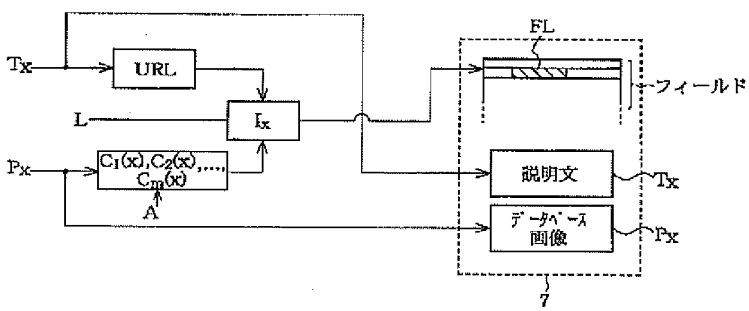
【図１】



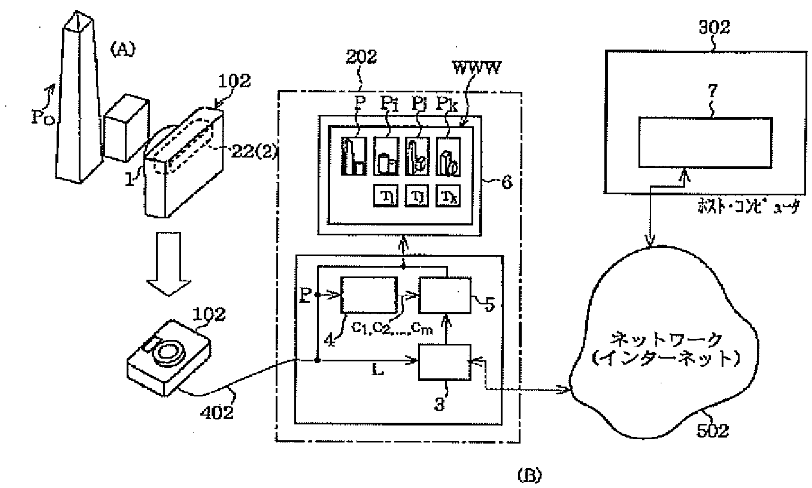
【図２】



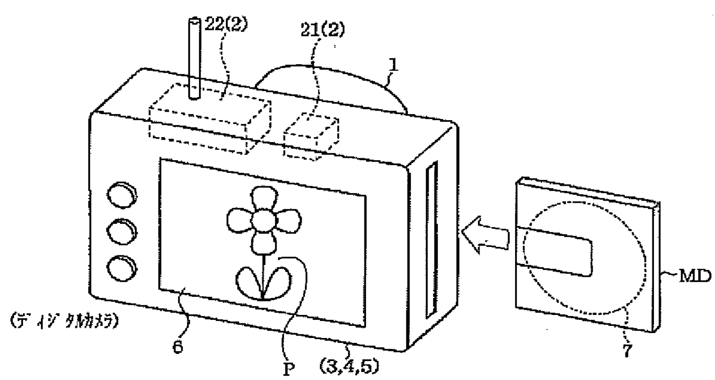
【図４】



【図３】


(A)
Po
102
22(2)
1
102
402
202
WWW
P
Pi
Pj
Pk
Ti
Tj
Tk
6
P
4
C1,C2,...,Cm
5
L
3
302
7
ホスト・コンピュータ
ネットワーク
(インターネット)
502
(B)

【図５】


22(2)
21(2)
1
MD
(ディジタルカメラ)
6
P
(3,4,5)
7

(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号

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		15/403	３２０Ｚ
			３５０Ｚ

審査請求　未請求　請求項の数４　ＯＬ　（全 17 頁）

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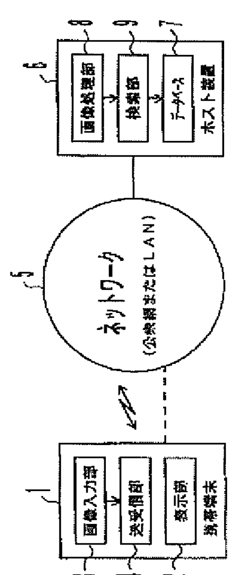
(54)【発明の名称】　データ検索システム

(57)【要約】

【課題】　データベース検索のユーザインタフェースを向上させる。

【解決手段】　データベース７には、複数の人物の画像データ、およびそれら各人物に関連する情報とが互いに対応づけられて格納されている。携帯端末１のユーザは、ある人物に関連する情報を得たい場合には、携帯端末１が備える電子カメラ（画像入力部３）を用いてその人物を撮影し、検索依頼とともにその画像データをホスト装置６に送る。検索部９は、受信した画像データを検索キーとしてデータベース７にアクセスし、受信した画像データと一致または類似する画像データに対応する情報を取り出す。

本実施形態のシステム構成図



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【特許請求の範囲】

【請求項１】　画像を読み取る読取手段と、
画像データとその画像データに関連する情報とを互いに対応づけて格納する格納手段と、
上記読取手段によって読み取られた画像の画像データに基づいて上記格納手段からその読取手段によって読み取られた画像の画像データに対応する情報を取り出す検索手段と、
を有するデータ検索システム。

【請求項２】　上記格納手段に格納されている画像データは、上記読取手段を用いて予め読み取っておいた画像の画像データである請求項１に記載のデータ検索システム。

【請求項３】　上記格納手段は、当該格納手段が格納している画像データからその特徴を抽出することによって得られた画像特徴データをその画像データに対応づけて格納しており、
上記検索手段は、上記読取手段によって読み取られた画像の画像データからその特徴を抽出し、その抽出した特徴と上記画像特徴データとの類似度に基づいて上記読取手段によって読み取られた画像の画像データに対応する情報を取り出す請求項１に記載のデータ検索システム。

【請求項４】　携帯端末からホスト装置に検索を依頼する構成のデータ検索システムであって、
上記携帯端末は、
画像を読み取る読取手段と、
該読取手段が画像を読み取った位置を検出する位置検出手段と、
を備え、
上記ホスト装置は、
対象物が存在する地域ごとに各対象物の画像データとその対象物に関連する情報とを互いに対応づけて格納する格納手段と、
上記位置検出手段によって検出された位置データおよび上記読取手段によって読み取られた画像の画像データに基づいて上記格納手段からその読取手段によって読み取られた画像の画像データに対応する情報を取り出す検索手段と、
を備えたデータ検索システム。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、データベース検索に係わり、特にデータベース検索のユーザインタフェースを向上させる技術に係わる。

【０００２】

【従来の技術】近年、様々な分野においてデータベースシステムが普及してきている。データベースシステムは、膨大な情報を所定の規則に従って格納しており、検索キーを入力すると、その検索キーに関連する情報が得られる。

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【０００３】データベースシステムは、通常、情報を格納する大型記憶装置と、ユーザからの検索依頼に従って上記記憶装置からその検索依頼に関連する情報を取り出す情報処理装置とから構成される。また、近年では、データベースをネットワーク上に設け、ユーザがネットワークを介してそのデータベースにアクセスできるようにした構成が広く利用されている。

【０００４】データベースに格納される情報は、テキストデータ等の文字情報が最も一般的であったが、近年では、画像データや場合によっては音声データも格納されている。

【０００５】

【発明が解決しようとする課題】既存のデータベースシステムでは、通常、キーボード、マウス、または手書きペン等を用いて検索キーを入力していた。即ち、検索キーを入力する際には、キーボードや手書きペンを用いてキーワードや検索範囲を入力したり、あるいは、対話形式で表示されるメニューに従ってその中の所望の項目をマウスで選択したりすることが一般的であった。

【０００６】ところが、キーボードやマウスによる操作は必ずしもすべてのユーザにとって容易とは言えず、その操作が不得手なユーザもいる。また、検索キーとして何を入力したら良いのかがわからない場合も多々ある。このため、データベースシステムをより広く普及させるためには、そのユーザインタフェースの向上（操作性の改良）が必要になると考えられる。

【０００７】本発明の課題は、データベース検索のユーザインタフェースを向上させることである

【０００８】

【課題を解決するための手段】本発明のデータ検索システムは、画像を読み取る読取手段と、画像データとその画像データに関連する情報とを互いに対応づけて格納する格納手段と、上記読取手段によって読み取られた画像の画像データに基づいて上記格納手段からその読取手段によって読み取られた画像の画像データに対応する情報を取り出す検索手段とを有する。

【０００９】上記検索手段は、上記読取手段によって読み取られた画像の画像データと、上記格納手段に格納されている画像データとを比較し、類似度が高ければ、その格納手段に格納されている画像データに対応づけられて格納されている情報を取りす。このことにより、上記読取手段によって読み取られた画像の画像データを検索キーとしてその画像データに関連する情報を上記格納手段から取り出すことができる。

【００１０】上記格納手段に予め格納しておく画像データとして、上記読取手段を用いて読み取った画像の画像データを用いてもよい。このように、上記格納手段に予め格納しておく画像データと、検索キーとしての画像データとを同じ装置で取り込むと、対象物が同一であれば、類似度が高い画像データが得られ、検索精度が向上

する。

【００１１】

【発明の実施の形態】以下、本発明の実施形態について図面を参照しながら説明する。図１は、本実施形態のシステム構成図である。携帯端末１は、通信機能を備えており、ネットワーク５に接続された他の装置にデータ処理を依頼し、その結果を受け取って例えば液晶ディスプレイからなる表示部２に表示できる。携帯端末１は、最寄りの基地局を介して無線でデータを送受信する方式、通信機能を持った装置（光リンクユニット）との間でＩｒ（赤外線）通信等でデータを送受信する方式、または有線でデータを送受信する方式でネットワーク５に接続される。また、携帯端末１は、たとえば電子カメラ等からなる画像入力部３を備え、それを用いて取り込んだ画像データをネットワーク５に接続された他の装置（たとえば、ホスト装置６）に検索キーとして送ってデータベース検索を依頼する機能を持っている。ネットワーク５とのインタフェースは、送受信部４によってなされる。

【００１２】ネットワーク５は、公衆網（公衆電話網、ＰＨＳ網など）、またはＬＡＮであり、ホスト装置６を収容している。ホスト装置６は、サーバマシンであり、携帯端末１から転送されてくる依頼（検索依頼）に従ってデータ処理（データベース検索）を実行する。データベース７には、画像データとその画像データに関連する情報とが予め対応づけられて格納されている。画像処理部８は、携帯端末１から送られてくる画像データに対してパターン認識処理を実行し、受信した画像データの特徴を抽出する。検索部９は、画像処理部８によって抽出された画像の特徴を用いてデータベース７にアクセスして検索結果を得る。ホスト装置６は、検索結果を携帯端末１に送出する。

【００１３】上記構成において、携帯端末１のユーザは、ある対象物（たとえば、人物）に関連する情報を得たいときには、まず、画像入力部３を用いてその対象物の画像データを取り込む。たとえば、画像入力部３が電子カメラである場合には、ユーザは、その対象物を撮影する。そして、その画像入力部３で取り込んだ画像データを検索キーとしてホスト装置６へ送出することにより、データベース検索を依頼する。

【００１４】ホスト装置６は、携帯端末１から検索依頼とともに画像データを受信すると、画像処理部８は、その対象物の画像の特徴を抽出する。たとえば、対象物が人物であれば、画像処理部８は、その人物の顔の輪郭や、目、鼻、口等の形状を検出し、その検出した特徴パターンを検索部９に渡す。なお、画データからその特徴を抽出する処理は必須ではないが、データベース検索の効率や精度を高める上で有用である。

【００１５】検索部９は、携帯端末１から受信した画像データを検索キーとしてデータベース７をサーチする。ここで、データベース７には、上述したように、画像データとその画像データに関連する情報とが予め対応づけられて格納されており、検索部９は、その画像データと一致または類似する画像データを抽出し、その抽出した画像データに関連する情報を取り出す。

【００１６】このように、本実施形態の検索システムは、画像データをキーとしてデータベースを検索する構成であり、ある対象物に関連する情報を得たいときには、ユーザは、その対象物の画像を電子カメラ等を用いて取り込んでその画像データをホスト装置に送って検索を依頼するだけでよい。即ち、ユーザの操作としては、対象物の画像を電子カメラ等で読み取るだけであり、非常に簡単である。また、検索の効率や精度を高めるための特徴抽出処理は、高性能のプロセッサや大きなメモリ領域を必要とするが、本実施形態のシステムでは、この特徴抽出処理はホスト装置側で実行される。このため、携帯端末１は、画像を読み取る機能および通信機能のみを備えればよく、携帯端末１の軽量化、低コスト化が計れる。

【００１７】なお、検索結果は、ホスト装置６に保存してもよいし、自動的にあるいは必要に応じて携帯端末１に転送してもよい。また、検索結果を予め指定されている所定の端末装置に転送してもよい。携帯端末１は、ホスト装置６から検索結果を受信すると、その検索結果を表示部２に表示する。

【００１８】また、データベース７は、ホスト装置６内に設けてもよいし、ホスト装置６の外部に設けてネットワーク５を介してホスト装置６に接続される構成であってもよい。

【００１９】図２は、携帯端末１の外観図である。携帯端末１は、ＬＣＤ表示部１１、カメラ１２、ＩＣカード用スロット１３、無線通信用アンテナ１４を備えている。また、他の通信方式をサポートするために、Ｉｒ通信のためのソケット１５や、有線通信用のソケット１６なども備えている。ＬＣＤ表示部１１は、タッチパネル構成であり、携帯端末１は手書き入力情報を処理することができる。スイッチ１７はカメラ１２より画像を取り込む撮影用のスイッチである。

【００２０】図３は、携帯端末１の構成図である。ＣＰＵ２１は、記憶装置２２（ＲＯＭおよびＲＡＭ）に格納されているプログラムを実行する。ＣＰＵ２１と記憶装置２２とはバス２３を介して互いに接続されている。

【００２１】記憶装置２２は、半導体メモリ、磁気的記録媒体、あるいは光学的記録媒体で構成され、プログラムおよびデータ等を格納している。記憶装置２２は、携帯端末１に固定的に設けたものであってもよいし、着脱自在に装着するものであってもよい。

【００２２】記録媒体ドライバ２４は、バス２３に接続されており、可搬性記録媒体（半導体メモリ、磁気ディスク、光ディスク、光磁気ディスクを含む）２５に格納されているデータを読み出したり、あるいは可搬性記録

媒体２５にデータを書き込む装置である。可搬性記録媒体２５の一例としては、ＩＣカードを想定する。ＣＰＵ２１は、可搬性記録媒体２５に格納されているプログラムを実行することもできる。

【００２３】なお、記憶装置２２に記録するプログラムおよびデータ等は、通信回線などを介して接続された他の機器から受信して記録する構成にしてもよく、さらに、ＣＰＵ２１が他の機器側に設けられた記憶装置に格納されているプログラムおよびデータ等を通信回線などを介して使用するようにしてもよい。

【００２４】ＬＣＤ表示部１１に対応するユニットは、液晶ディスプレイ（ＬＣＤ）３１、液晶ディスプレイ３１に表示すべき情報を格納するメモリ３２、ＬＣＤ制御部３４の制御に従ってメモリ３２に格納されている情報を液晶ディスプレイ３１に出力するＬＣＤドライバ３３、メモリ３２およびＬＣＤドライバ３３を制御するＬＣＤ制御部３４、タッチパネル部３５、およびタッチパネル部３５が検出した入力情報をＣＰＵ２１に通知するタッチパネル制御部３６から構成される。

【００２５】カメラ１２は、たとえばＣＣＤカメラであり、その出力はＡ／Ｄコンバータ３７によってビットマップ形式のデジタルデータに変換されてメモリ３８に書き込まれる。カメラ制御部３９は、ＣＰＵ２１の指示に従って、メモリ３８に保持されている画像データをバス２３に出力する。

【００２６】マイク４５は、携帯端末１の周囲の音声等を入力する。マイク４５によって取り込まれた音声データは、Ａ／Ｄコンバータ４６によってデジタル信号に変換される。マイク制御部４７は、ＣＰＵ２１の指示に従い、Ａ／Ｄコンバータ４６の出力をバス２３に送出する。

【００２７】ＧＰＳ装置４８は、人工衛星からの信号に基づいて携帯端末１の現在位置を検出する。ＧＰＳ装置４８の出力は、ＣＰＵ２１の指示に従って、汎用コネクタ４９を介してバス２３に出力される。

【００２８】通信制御部４０は、携帯端末１からデータを送出する際には、ＣＰＵ２１の指示に従って送信パケットを生成して無線トランシーバ４１、４２または有線トランシーバ４３に渡す。また、データを受信する際には、無線トランシーバ４１、４２、または有線トランシーバ４３を介して受信したパケットに格納されているデータをバス２４上に出力する。無線トランシーバ４１は、図３に示した無線通信用アンテナ１４に接続されており、無線基地局４との間で無線データを授受する。無線トランシーバ４２は、Ｉｒ通信を行うための送受信機であり、また、有線トランシーバ４３は例えばモデムである。無線トランシーバ４２および有線トランシーバ４３は、オプションで着脱される。なお、携帯端末１は、さらに時計４４を備えている。

【００２９】図４は、携帯端末１においてカメラ撮影により読み取った画像データをホスト装置６に転送してデータベースの作成またはデータベースの検索を依頼する処理のフローチャートである。このフローチャートに示す各機能を実現するプログラムは、ＣＰＵ２１が読み取り可能なプログラムコードの形態で記憶装置２２に格納されている。

【００３０】また、図４のフローチャートは、携帯端末１が入力待ち状態において何らかの入力を検出した後の処理を示している。以下の説明では、ユーザが対象物を電子カメラで撮影することによってその画像を読み取る例を説明する。

【００３１】ステップＳ１では、スイッチ１７の操作によってカメラ１２から画像データが入力された場合であるかを調べ、カメラ１２からの入力であればステップＳ２以降の処理を実行し、他の入力であれば、ステップＳ２１においてその入力に対応する他の処理を実行する。このように、ユーザが携帯端末１のカメラ１２を用いて撮影すると、ステップＳ２以降の処理が開始される。なお、カメラ入力があったときには、ＧＰＳ装置４８の出力を保持しておく。

【００３２】ステップＳ２では、カメラ１２によって取り込まれた画像データをＬＣＤ表示部１１に表示する。すなわち、カメラ１２によって取り込まれた画像データをＬＣＤ表示部１１のメモリ３２に書き込み、その画像データを液晶ディスプレイ３１に表示する。続いて、ステップＳ３では、ユーザ指示入力画面を表示する。ユーザ指示入力画面は、カメラ撮影により読み取った画像をホスト装置６に送って処理を依頼するのか否かをユーザに指定させるための画面であり、カメラ撮影により読み取った画面上にウィンドウ表示する。この場合、記憶装置２２に格納されているユーザ指示入力画面の画像データを読み込んで表示する。ユーザ指示入力画面は、例えば「データベースに保存」、「データベース検索」、「自端末に保存」、及び「キャンセル」というボタンを含む。従って、ステップＳ２およびＳ３により、ＬＣＤ表示部１１には、撮影対象物の画像に加え、その画像の上に上記４つのボタンが設けられた状態が表示される。

【００３３】上記ユーザ指示入力画面に対してユーザが指示を入力すると、すなわち、ユーザが表示されたボタンの中の１つのボタンを押圧すると、ステップＳ４以下の処理が実行される。まず、ステップＳ４においてユーザの指示を認識する。この処理は、ユーザがどのボタンを押圧したかを検出するものである。つづいて、ステップＳ５では、ユーザの指示が、ホスト装置６への処理依頼であるか否かを調べる。「データベースに保存」または「データベース検索」が押圧されたのであれば、ユーザの指示がホスト装置６への処理依頼であると見なしてステップＳ６へ進み、他のボタンが押圧されたのであれば、ステップＳ１０へ進む。

【００３４】ステップＳ６では、カメラ１２を用いて取

り込んだ画像データをホスト装置６に転送するためのパケットを作成する。ステップＳ６の処理については後述説明する。そして、ステップＳ７において、ホスト装置６との間にリンクが確立されているか否かを調べ、既にリンクが確立されていた場合には、作成したパケットをステップＳ８において図１に示すネットワーク５に送出する。一方、ホスト装置６との間にリンクが確立されていなければ、ステップＳ９でリンクを確立した後にステップＳ８へ進む。

【００３５】ユーザの指示がホスト装置６への処理依頼ではないと判断された場合には（ステップＳ５：Ｎｏ）、ステップＳ１０において、「自端末に保存」が押圧されたか否かを判断する。「自端末に保存」が押圧されたのであれば、ステップＳ１１において携帯端末１側で画像データを保存する。一方、「自端末に保存」が押圧されたのでなければ、「キャンセル」が押圧されたものと見なし、ステップＳ１２においてその画像データを廃棄する。

【００３６】このように、携帯端末１は、対象物の画像を読み取ると、その画像データをパケットに格納してホスト装置６に送る。図５(a) は、携帯端末１から送出されるパケットの構造を示す図である。このパケットは、図４に示すステップＳ６において作成される。

【００３７】各パケットは、ヘッダ部およびデータ部から構成される。ヘッダ部は、送信元アドレスおよび着信先アドレスなどを格納する。送信元アドレスおよび着信先アドレスとしてどのようなアドレス体系のアドレスを格納するのかは、本実施形態が適用されるネットワーク構成によって決まり、たとえば、TCP/IP通信では、ＩＰアドレスが格納される。

【００３８】データ部には、アプリケーション識別情報、端末ＩＤ、画像データ、ＧＰＳデータ等が格納される。アプリケーション識別情報は、着信先の端末（ここでは、ホスト装置６）において起動すべきアプリケーションプログラムを識別する情報である。すなわち、着信先の端末において所定のプログラムを起動するためのコマンドである。本実施形態においては、アプリケーション識別情報は、図４のステップＳ４において検出したユーザ指示（すなわち、「データベースの作成」または「データベースの検索」）に従って設定される。なお、アプリケーション識別情報は、TCP/IP通信では、ポート番号として指定してもよい。

【００３９】端末ＩＤは、送信元を識別する情報であり、ここでは、携帯端末１の識別番号である。画像データは、カメラ１２により取り込まれた画像データであり、パケットに格納されるときには圧縮される。ＧＰＳデータは、ＧＰＳ装置４８の出力であり、このパケットに格納される画像データの画像が撮影されたときの携帯端末１の位置を表す情報である。

【００４０】図５(b) は、図４に示すステップＳ６パケット作成処理の詳細フローチャートである。ステップＳ３１では、ホスト装置６へ転送する画像データを圧縮し、データ部に格納する。圧縮方式は、例えばＪＰＥＧである。ステップＳ３２では、ＧＰＳデータを格納する。ステップＳ３３では、アプリケーション識別情報として、「データベースの作成」または「データベースの検索」を設定する。ステップＳ３４では、携帯端末１を識別する情報（自機を識別する情報）として端末ＩＤを設定する。さらに、ステップＳ３５においてヘッダ部を作成する。ヘッダ部には、少なくとも、送信元アドレスとして携帯端末１のアドレス（自機のアドレス）、および着信先アドレスとしてホスト装置６のアドレスを設定する。

【００４１】上述のようにして作成されたパケットは、ネットワーク５に送出される。ネットワーク５は、パケットの着信先アドレスに従ってそのパケットをホスト装置６へ転送する。以下に、このパケットを受信して処理するホスト装置６について説明する。

【００４２】図６は、ホスト装置６の構成図である。記憶装置５１は、半導体メモリ、磁気的記録媒体、あるいは光学的記録媒体で構成され、プログラムおよびデータ等を格納している。記憶装置５１は、ホスト装置６に固定的に設けたものであってもよいし、着脱自在に装着するものであってもよい。

【００４３】記録媒体ドライバ５２は、可搬性記録媒体（半導体メモリ、磁気ディスク、光ディスク、光磁気ディスク等を含む）５３に格納されているデータを読み出したり、あるいは可搬性記録媒体５３にデータを書き込む装置である。通信制御部５４は、ネットワークとの間でのデータの授受を制御するユニットである。携帯端末１との間のパケットの送受信もここで制御される。

【００４４】ＣＰＵ５５は、記憶装置５１または可搬性記録媒体５３からプログラム等をメモリ５６にロードして実行する。なお、記憶装置５１に記録するプログラムおよびデータ等は、可搬性記録媒体５３に格納されていたものを書き込んだものであってもよく、また、通信回線などを介してネットワーク上の他の機器から受信して記録する構成にしてもよい。さらに、ＣＰＵ５５は、ネットワーク上に設けられた他の記憶装置に格納されているプログラムおよびデータ等を通信回線などを介して使用するようにしてもよい。

【００４５】図７は、ホスト装置６の処理を説明するフローチャートである。ここでは、ホスト装置６が携帯端末１から送出されたパケット（図４のフローチャートの処理によって作成されたパケット）をネットワーク５から受信した場合の動作を説明する。

【００４６】ステップＳ４１でパケットを受信すると、ステップＳ４２でそのパケットに設定されている端末ＩＤを調べることによってそのパケットを送出した端末を認識する。ステップＳ４３では、受信したパケットに設

定されているアプリケーション識別情報によって指定されているアプリケーションを起動する。ステップＳ４４では、起動されたアプリケーションが「データベースの作成」であるか否かを調べる。「データベースの作成」であれば、ステップＳ４５において、データベース作成処理を実行する。なお、データベース作成処理については後述詳しく説明する。

【００４７】起動されたアプリケーションが「データベースの作成」でなかった場合は（ステップＳ４４：Ｎｏ）、ステップＳ４６において、そのアプリケーションが「データベースの検索」であるか否か調べる。「データベースの検索」であれば、ステップＳ４７において、データベース検索処理を実行する。なお、データベース検索処理についても後述詳しく説明する。もし、起動されたアプリケーションが「データベースの作成」または「データベースの検索」のいずれでもなかった場合には、ステップＳ４８において他の処理を実行する。

【００４８】図８は、データベースの構成図である。データベース７は、本実施例では、端末ＩＤごとに情報を格納する。すなわち、各端末ごとに（各端末のユーザ毎に）データベースが構築される。そして、ホスト装置６は、データベース７の検索依頼を受け取ると、上記ステップＳ４２で検出した端末ＩＤに対応する領域にアクセスする。

【００４９】各端末ＩＤごとに割り当てられた領域には、それぞれ、画像データ格納領域６１、テンプレート格納領域６２、関連情報格納領域６３が設けられる。これらの領域６１～６３に格納される情報の例を図９に示す。ここでは、画像データの対象物として人物を扱う例を示している。

【００５０】画像データ格納領域６１には、カメラ等を用いて撮影した画像の画像データが格納される。また、テンプレート格納領域６２には、画像データ格納領域６１に格納される各画像データから特徴を抽出することによって得られたテンプレートが格納される。このテンプレートは、対象物（ここでは、人物）の画像に対して特徴抽出処理を施すことによって得られた輪郭や線の情報などである。さらに、関連情報格納領域６３には、画像データ格納領域６１に格納される各画像データに関連する情報が格納される。ここでは、画像データとして格納されている各人物に関する住所録等のデータベース情報が格納されている。なお、これらの関連情報は、たとえば、テキスト形式、ＣＳＶ形式等として格納されている。

【００５１】各端末ＩＤごとに割り当てられた領域には、さらにそれぞれアドレステーブル６４が設けられている。アドレステーブル６４には、画像データ格納領域６１に格納されている各画像データの格納アドレスと、テンプレート格納領域６２に格納されている各テンプレートの格納アドレスと、関連情報格納領域６３に格納されている関連情報の格納アドレスとが互いに対応づけられて格納されている。

【００５２】図１０は、データベース作成処理のフローチャートである。このフローチャートは、携帯端末１から転送されてきた画像データをデータベース７に格納する際の処理を示す。なお、以下では、図７のステップＳ４２で認識した端末ＩＤ（携帯端末１の端末ＩＤ）に対して割り当てられている領域内にその端末ＩＤの端末から転送されてきた画像データを格納するものとする。

【００５３】ステップＳ５１では、受信パケットから画像データを抽出する。この画像データは、この時点では、圧縮されたままの状態である。ステップＳ５２では、ステップＳ５１で抽出した画像データを画像データ格納領域６１に格納する。なお、この画像データ格納領域６１は、図７のステップＳ４２で認識した端末ＩＤに対して割り当てられている領域内に設けられているものである。

【００５４】ステップＳ５３では、上記端末ＩＤに対して設けられているアドレステーブル６４を参照し、未使用の画像ＩＤを１つハントする。図８に示す例では、たとえば画像ＩＤ＝３をハントする。そして、ステップＳ５４において、ステップＳ５２で画像データを格納したアドレスをステップＳ５３でハントした画像ＩＤに対応づけてアドレステーブル６４に保持する。

【００５５】ステップＳ５５では、ステップＳ５１で抽出した画像データを解凍する。ステップＳ５６では、この解凍した画像データに対してノイズ除去などの前処理を実行する。ステップＳ５７では、上記画像データの特徴を抽出する処理として、その画像データに含まれる線およびエッジを検出する。線・エッジを検出する処理は、既知の技術である。たとえば、画像データの濃度分布あるいは色分布を調べたときに、「線」または「エッジ」は、その分布の変化率の大きい点を連続させたものとして検出可能である。なお、「線」と「エッジ：ある領域と他の領域との境界」とを識別する技術も既知である。そして、ステップＳ５８において、ステップＳ５７の処理によって得られた線およびエッジ等に基づいてテンプレートを作成する。

【００５６】ステップＳ５９では、作成したテンプレートをテンプレート格納領域６２に格納する。なお、このテンプレート格納領域６２も、図７のステップＳ４２で認識した端末ＩＤに対して割り当てられている領域内に設けられているものである。そして、ステップＳ６０において、ステップＳ５９でテンプレートを格納したアドレスをステップＳ５３でハントした画像ＩＤに対応づけてアドレステーブル６４に保持する。

【００５７】上記手順により、携帯端末１からデータベースの作成依頼とともに画像データが転送されてくると、データベース７内の携帯端末１に割り当てられた領域内にその画像データとその画像データに基づいて作成

されたテンプレートとが対応づけられて格納される。

【００５８】図１１は、データベース作成処理のフローチャートであり、図１０の処理により格納してある画像データに関連する情報をその画像データに対応づけて書き込む処理を示す。なお、同図のフローチャートは、ユーザに対話型のデータ入力インタフェースを提供してユーザがそれに従って関連情報を入力する場合のホスト装置６の動作を示している。また、ここでは、ユーザがホスト端末６において関連情報を入力するものとするが、ネットワーク５に接続された任意の端末装置からその関連情報を入力することも可能である。

【００５９】ステップＳ７１では、ユーザに端末ＩＤを入力させるための画面をホスト装置６のディスプレイに表示する。ここでは、ユーザが携帯端末１の端末ＩＤを入力したものとする。ステップＳ７２では、入力された端末ＩＤに対して割り当てられている領域内に格納されている画像データを表示する。複数の画像データが格納されている場合には、それらを縮小してホスト装置６のディスプレイに同時に表示してもよいし、ユーザからの指示に従って順次表示してもよい。

【００６０】ユーザが所望の画像データを選択すると、ステップＳ７３において、選択された画像データに関する情報を入力させるための領域をホスト装置６のディスプレイに表示する。この入力領域にユーザが文字列などを入力すると、ステップＳ７４において、その入力された情報（文字列など）をデータベース情報として関連情報格納領域６３に格納する。なお、ユーザは、対象物が人物の場合、例えば、その人物の氏名、住所、電話番号、以前に会ったときの会話の内容など入力する。そして、ステップＳ７５において、ユーザによって選択された画像データに対応させて、ユーザによって入力された情報を格納したアドレスをアドレステーブル６４に保持する。

【００６１】上記手順により、各画像ごとにその画像データと、その画像データから特徴を抽出したテンプレートと、その画像に対応する関連情報とがそれぞれ互いに対応づけられてデータベース７に格納される。

【００６２】図１２は、データベース検索処理のフローチャートである。このフローチャートは、図７のステップＳ４７の詳細説明であり、ホスト装置６が携帯端末１から検索依頼とともに画像データを受信したときに実行されるホスト装置６における処理である。

【００６３】ステップＳ８１～Ｓ８４は、図１０のステップＳ５１、Ｓ５５～Ｓ５７と同じ処理であり、受信パケットから抽出した画像データから線およびエッジ等を検出する。そして、ステップＳ８５では、ステップＳ８４において得られた線およびエッジ等に基づいて輪郭・線抽出画像を作成する。この処理は、基本的な動作としては、図１０のステップＳ５８のテンプレート作成処理と同じである。

【００６４】ステップＳ８６では、テンプレートマッチング処理を実行する。すなわち、ステップＳ８５で作成した輪郭・線抽出画像をキーとしてデータベース７にアクセスし、テンプレート格納領域６２に格納されている各テンプレートとの類似度を調べる。なお、このテンプレートマッチング処理では、図７のステップＳ４２で検出した端末ＩＤに対して割り当てられた領域内に設けられたテンプレート格納領域６２においてサーチするものとする。

【００６５】ステップＳ８７では、最も類似度の高いテンプレートに対応する関連情報を関連情報格納領域６３から読み出す。たとえば、ステップＳ８５で作成した輪郭・線抽出画像とテンプレート７１との類似度が最も高かった場合には、アドレステーブル６４を参照し、関連情報格納領域６３のアドレス＝p0001 に格納されている関連情報を読み出す。

【００６６】ステップＳ８８では、ステップＳ８７で読み出した関連情報を格納するパケットを作成する。このパケットは、その送信先アドレスとして図７のステップＳ４２で検出した端末ＩＤ（ここでは、携帯端末１の端末ＩＤ）に対応する端末のアドレスを設定する。そして、ステップＳ８９において、パケット送出先の端末との間にリンクが確立されているかを調べ、確立されていれば、ステップＳ９０においてそのリンクを介してステップＳ８８で作成したパケットを送出する。リンクが確立されていなければ、ステップＳ９１でリンクを確立した後にステップＳ９０へ進む。

【００６７】本実施形態の検索システムでは、データベース７に予め格納しておく画像データと、検索キーとしての画像データとを同じ装置（実施例では、携帯端末１のカメラ１２）で取り込むので、対象物が同一であれば、その類似度が高いと考えられる。ただし、データベース作成のためのカメラ撮影と検索キーを取り込む際のカメラ撮影とでは、たとえば対象物を撮影する際の撮影角度等を正確に一致させることは困難なので、そのことが画像データを検索キーとした検索精度を低下させる要因となる。

【００６８】このため、上記実施例では、図１２のステップＳ８８において、最も類似度が高いテンプレートに対応する関連情報を読み出しているが、類似度の高いものから順番に複数のテンプレートを選択し、それらのテンプレートにそれぞれ対応する関連情報を読み出して携帯端末１に送出するような構成としてもよい。

【００６９】また、上記実施例では、画像データの対象物として人物を扱っているが、本発明は、様々な対象物に適用できる。たとえば、データベースに予め様々な建造物の画像データとそれら各建造物の名称、建築様式、歴史などを対応づけて格納しておき、ユーザは、ある建造物に関する情報を得たいときには、携帯端末１を用いてその建造物を撮影して、検索依頼とともにその画像デ

ータをホスト装置６に送ることにより、その建造物に関する情報が得られる。

【００７０】ところが、建造物のように、検索対象の数が膨大な場合には、それに伴ってデータベースに格納しておく画像データの情報量も膨大になるが、データベースに格納される情報量が増えると、検索時間が長くなり、データベースとしては実用的でなくなる恐れがある。このため、例えば、建造物を対象とする場合には、図１３に示すように、地域ごとに分割してデータベースを作成しておく。そして、撮影した建造物の画像データをキーとして検索を依頼するときには、携帯端末１は、図５に示すように、その画像データを撮影したときに検出したＧＰＳデータもいっしょにホスト装置６へ送る。あるいは、携帯端末１の最寄りの基地局を識別する情報がホスト装置６へ転送されるようにしておく。

【００７１】ホスト装置６は、位置情報（ＧＰＳデータなど）に従って撮影された建造物が存在する地域を認識し、その地域のデータベースを検索する。以降の処理は、対象物を人物としたときと同じである。

【００７２】また、上記実施例では、画像データをキーとしてデータベースを検索しているが、対象物を人物とした場合には、検索補助情報として音声データを併用してもよい。この場合、データベースには、各人物の画像データに対応づけて、その人物の音声を予め録音して格納しておく。この音声情報は、その人物の音声の特徴を抽出した状態（たとえば、声紋、フォルマント）で格納しておく。そして、ユーザは、ある人物に関する情報を得たいときには、携帯端末１を用いてその人物を撮影するとともに、その人物の声を録音し、検索依頼とともにその画像データおよび音声データをホスト装置６に送出する。

【００７３】なお、上述したように、検索結果を即座に携帯端末１に返送することなく、ホスト装置６に保存してもよい。この場合、検索結果は、携帯端末１の端末ＩＤに対応づけて保存する。また、この検索結果を予め指定されている所定の端末装置に転送してもよい。

【００７４】上記実施形態において、ホスト装置６によって実行される処理プログラム、すなわち図７および図１０～図１２に示すフローチャートで示す各機能を実現するプログラム、およびネットワークを介して転送されてくる情報を解釈して処理するプログラム等は、ＣＰＵ５５が読み取り可能なプログラムコードの形態で記憶装置５１あるいは可搬性記録媒体５３に格納されている。あるいは、ネットワークを介して接続される他の装置に格納されているものを利用する。

【００７５】

【発明の効果】本発明の検索システムでは、携帯端末が備えるカメラ等で対象物の画像データを取り込み、その画像データをホスト装置に送出することによりその画像データに関連する情報が得られる。このように、本発明によれば、データ検索システムにおいて操作が簡単なユーザインタフェースが提供される。

【００７６】また、携帯端末としては、画像を読み取ってホスト装置へ転送する機能、およびホスト装置に処理を依頼する機能を備えていればよく、大容量のメモリや高性能プロセッサは必要ないので、小型・軽量・低コスト化が計れる。

【図面の簡単な説明】

【図１】本実施形態のシステム構成図である。

【図２】携帯端末の外観図である。

【図３】携帯端末の構成図である。

【図４】携帯端末においてカメラ撮影により取り込んだ画像データをホスト装置に転送する処理のフローチャートである。

【図５】(a) は、携帯端末から送出されるパケットの構造を示す図であり、(b) は、パケット作成処理の詳細フローチャートである。

【図６】ホスト装置の構成図である。

【図７】ホスト装置の処理を説明する概略フローチャートである。

【図８】データベースの構成図である。

【図９】データベースに格納される情報の例である。

【図１０】データベース作成処理のフローチャート（その１）である。

【図１１】データベース作成処理のフローチャート（その２）である。

【図１２】データベース検索処理のフローチャートである。

【図１３】他の実施例におけるデータベースの構成図である。

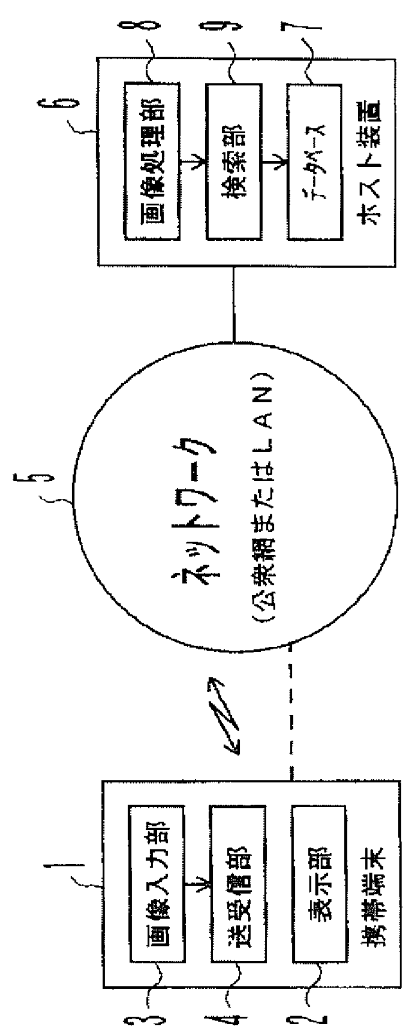
【符号の説明】

1	携帯端末
2	表示部
3	画像入力部
4	送受信部
5	ネットワーク
6	ホスト装置
7	データベース
8	画像処理部
9	検索部
１２	カメラ
２１	ＣＰＵ
２２	記憶装置
２４	記録媒体ドライバ
２５	可搬性記録媒体
３１	液晶ディスプレイ
４０	通信制御部
５１	記憶装置
５２	記録媒体ドライバ
５３	可搬性記録媒体

５４　　通信制御部
５５　　ＣＰＵ
＊５６　　メモリ
＊

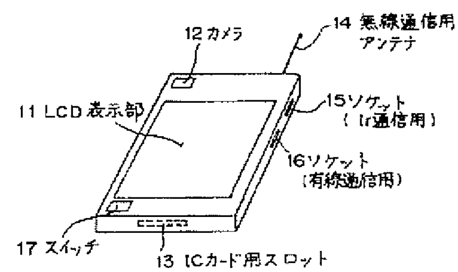
【図１】

本実施形態のシステム構成図



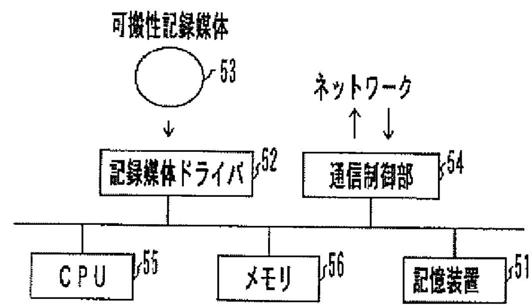
【図２】

携帯端末外観図



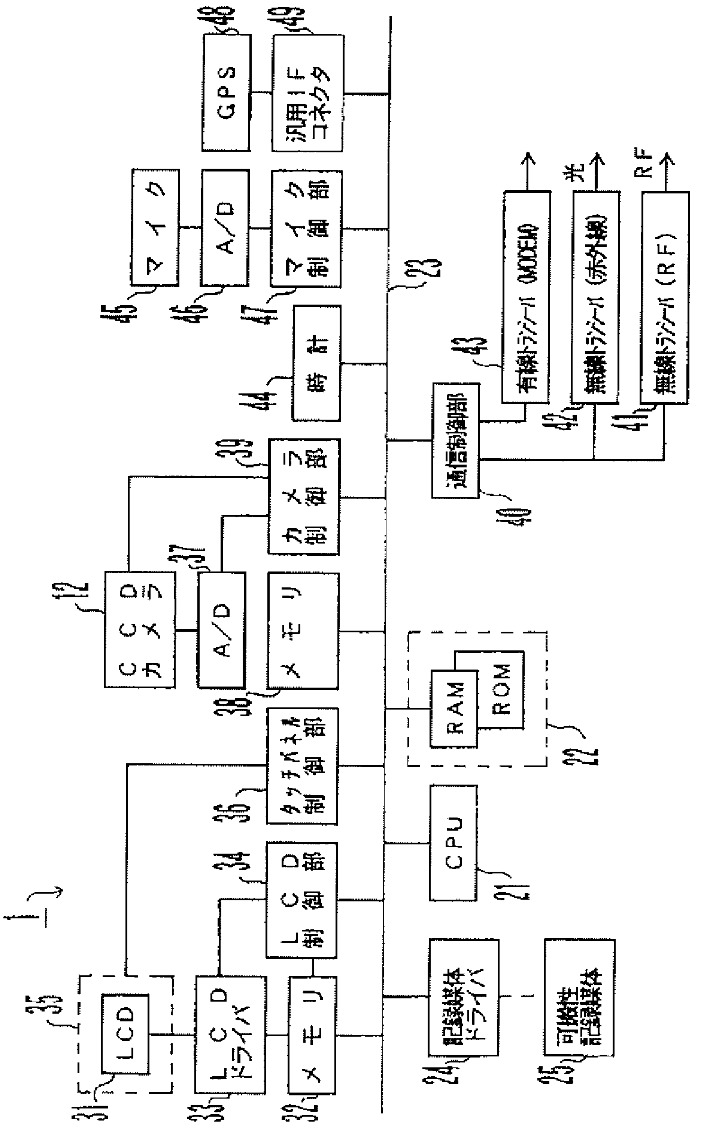
【図６】

ホスト端末の構成図



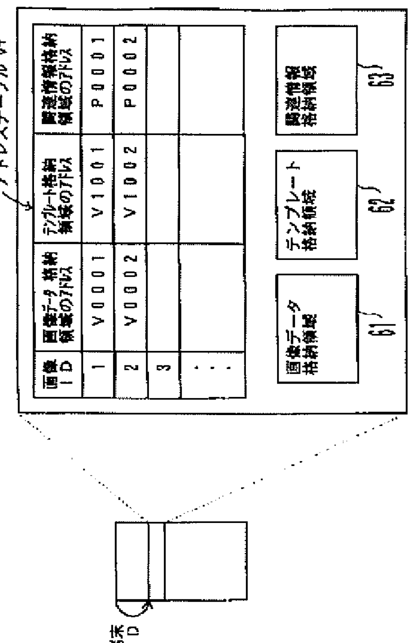
【図３】

携帯端末の構成図

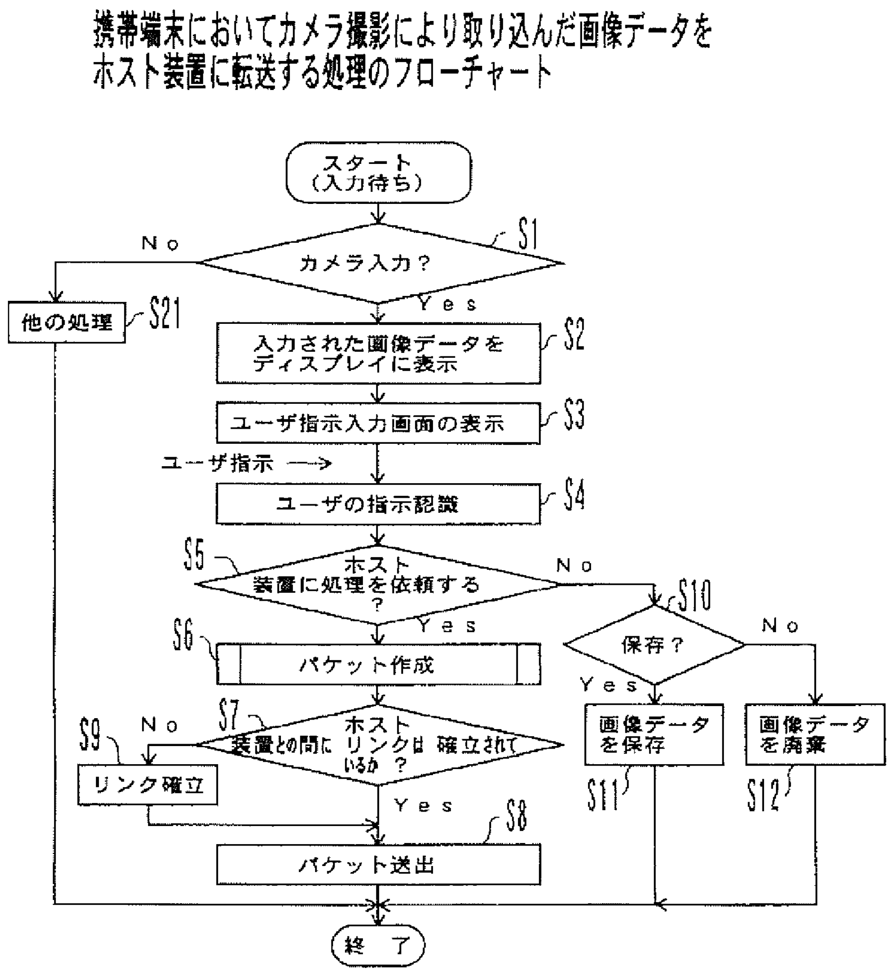


【図８】

ホストが管理するデータベースの構成



【図４】

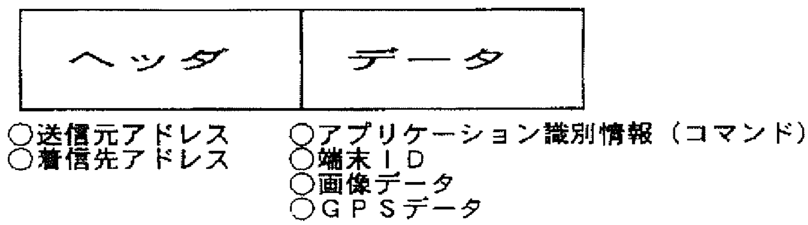


携帯端末においてカメラ撮影により取り込んだ画像データをホスト装置に転送する処理のフローチャート
スタート（入力待ち）
カメラ入力？
S1
No
Yes
他の処理
S21
入力された画像データをディスプレイに表示
S2
ユーザ指示入力画面の表示
S3
ユーザ指示
ユーザの指示認識
S4
S5
ホスト装置に処理を依頼する？
No
Yes
S10
保存？
No
Yes
S6
パケット作成
S7
ホスト装置との間にリンクは確立されているか？
No
Yes
S9
リンク確立
S8
パケット送出
画像データを保存
S11
画像データを廃棄
S12
終了

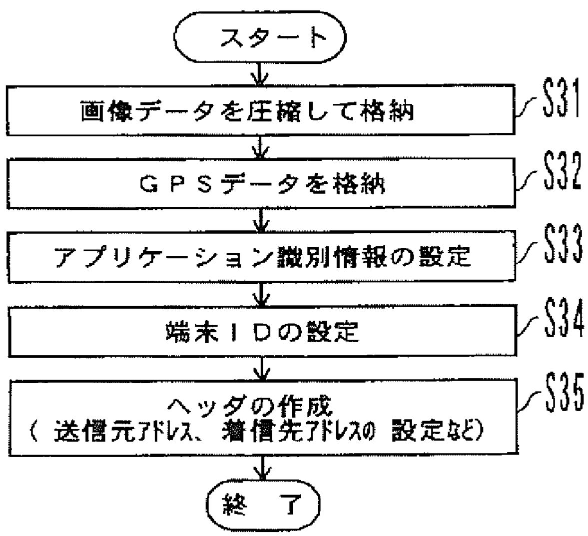
【図５】

(a) は携帯端末から送出されるパケットの構造を示す図
(b) はパケット作成処理の詳細フローチャート

(a)

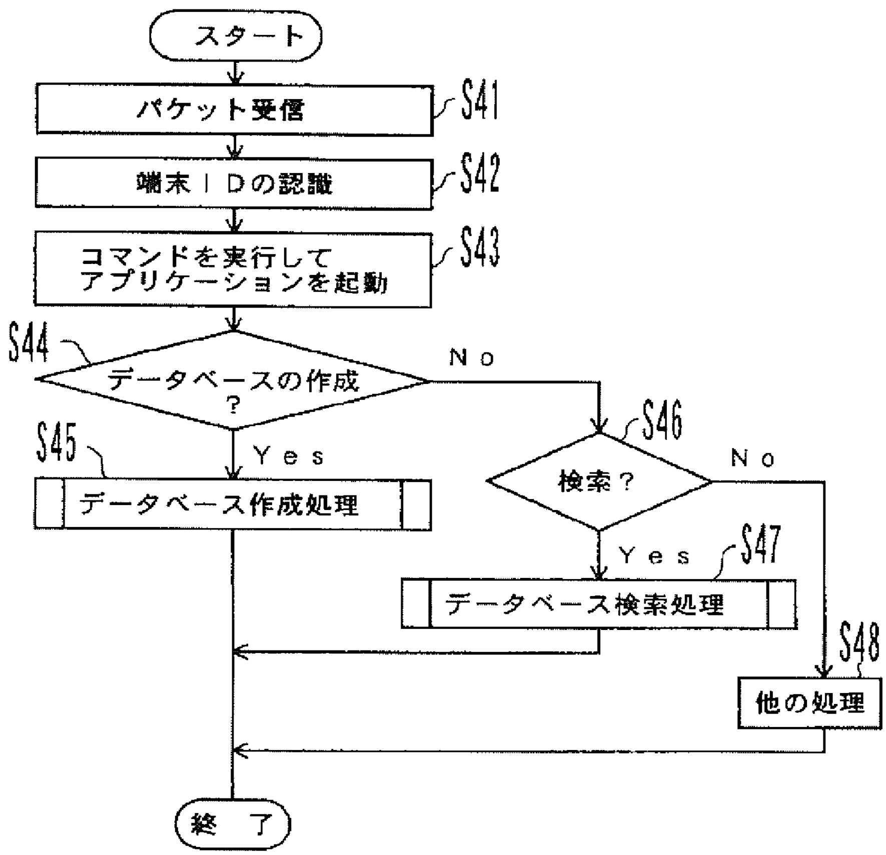


(b)



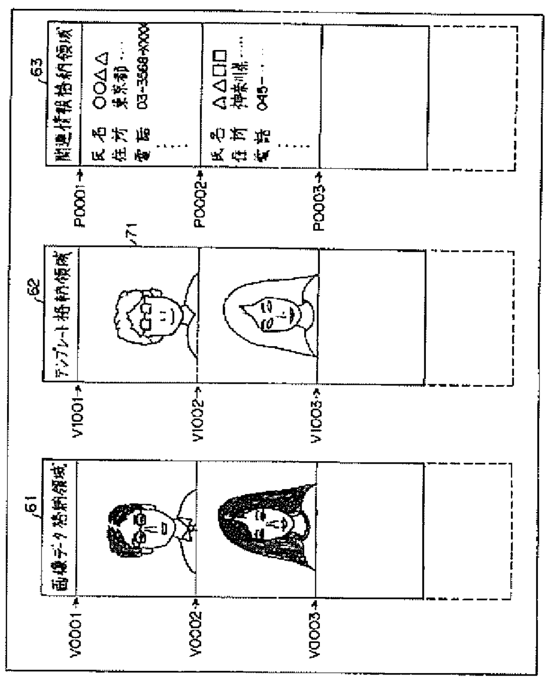
【図７】

ホスト装置の処理を説明する概略フローチャート



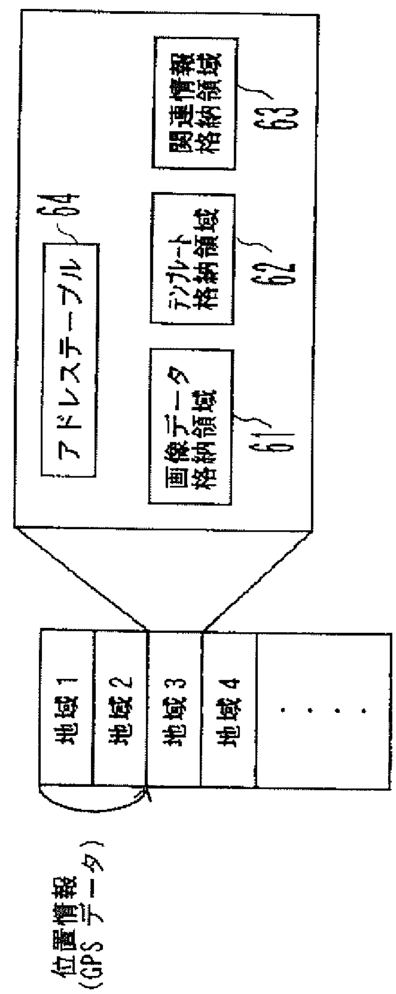
【図９】

データベースの例



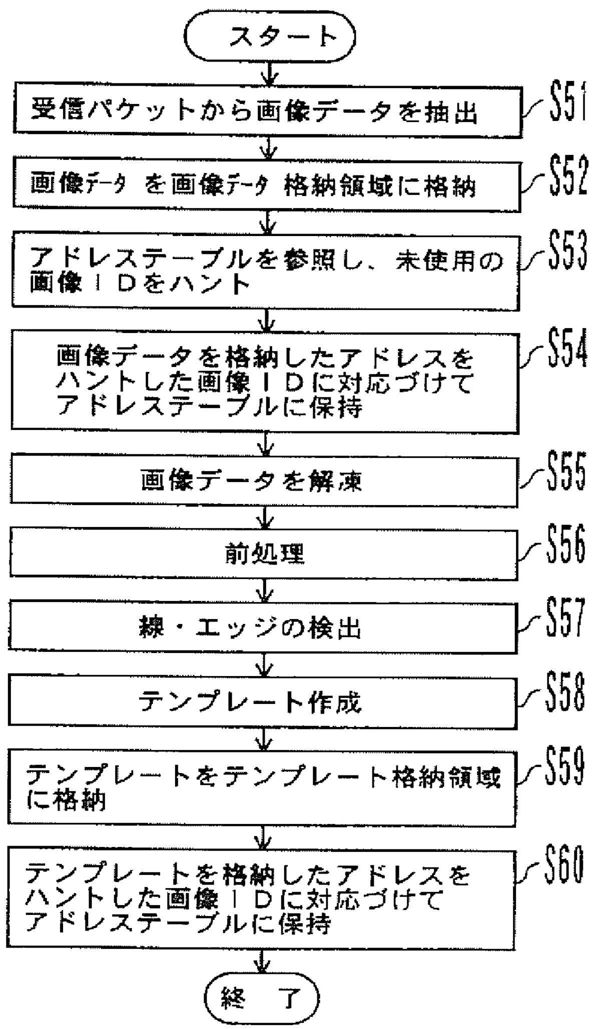
【図１３】

他の実施例におけるデータベースの構成図



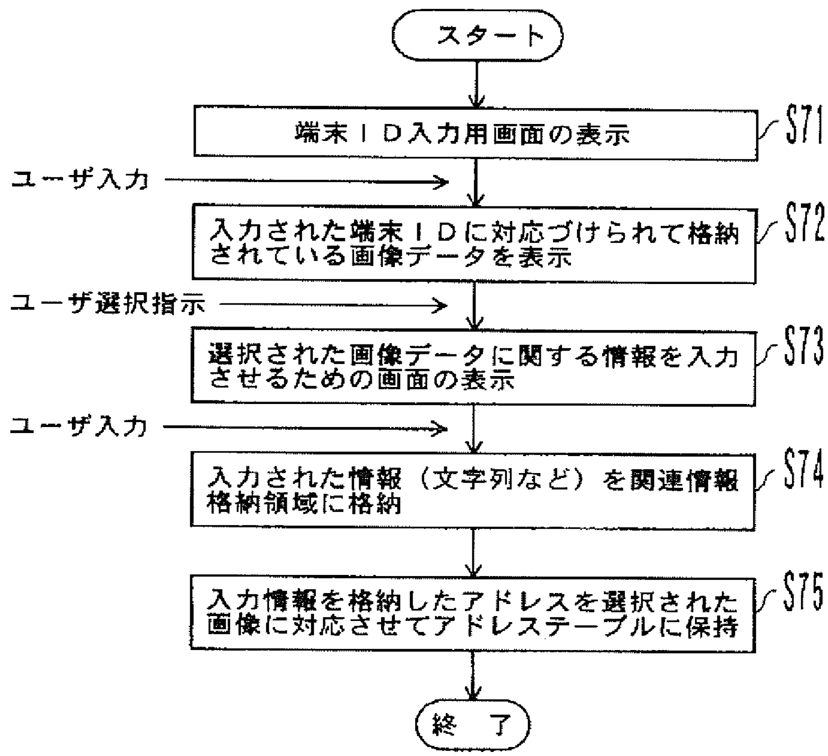
【図１０】

データベース作成処理のフローチャート（その１）

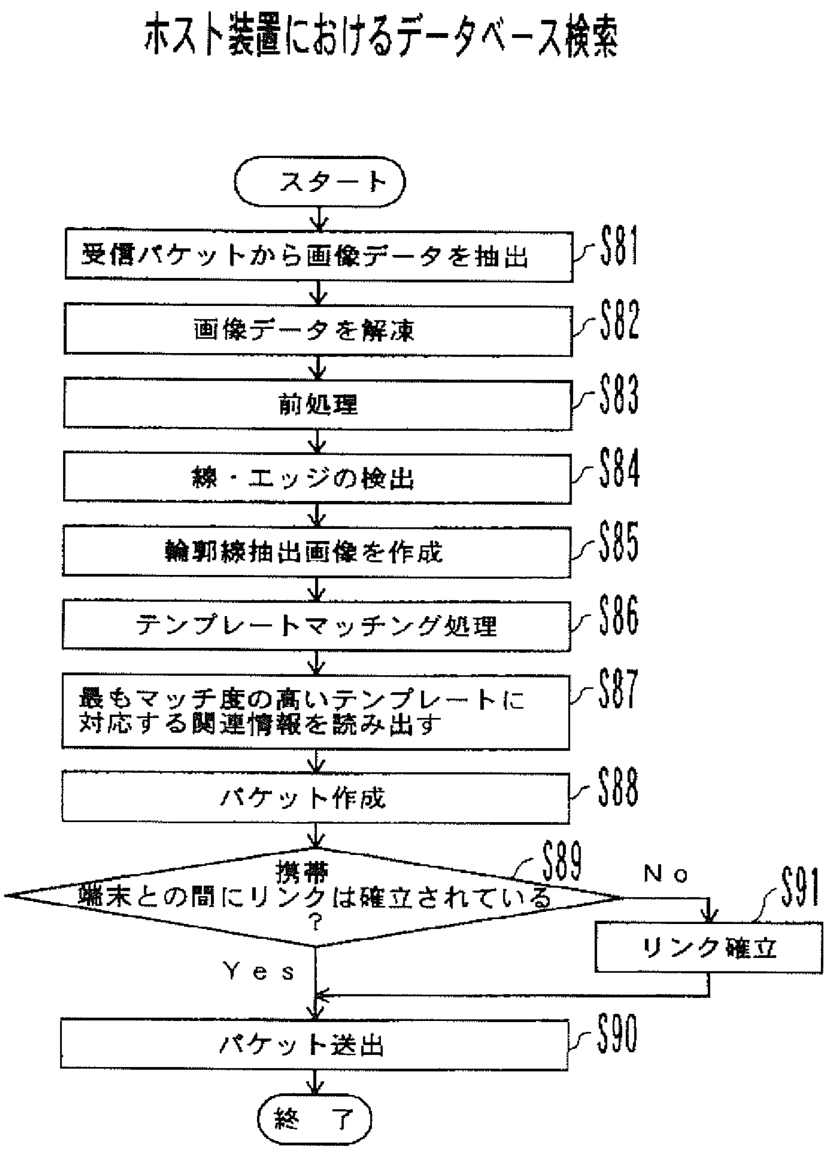


【図１１】

データベース作成処理のフローチャート（その２）



【図１２】


ホスト装置におけるデータベース検索
スタート
受信パケットから画像データを抽出
S81
画像データを解凍
S82
前処理
S83
線・エッジの検出
S84
輪郭線抽出画像を作成
S85
テンプレートマッチング処理
S86
最もマッチ度の高いテンプレートに対応する関連情報を読み出す
S87
パケット作成
S88
携帯端末との間にリンクは確立されている？
S89
No
リンク確立
S91
Yes
パケット送出
S90
終　了

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		15/403	３５０Ｃ	
		15/62	Ｐ	

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(54)【発明の名称】　画像識別装置及び画像識別に用いられるデータベースシステム

(57)【要約】

【課題】　美術品等の画像情報に基づき、その画像情報が表す物体の作者等の属性情報を知ることができる画像識別装置を提供することである。

【解決手段】　ディジタルカメラ１０が絵画１２を撮影し、その絵画のディジタル画像を生成する。特徴量算出手段１４は絵画のディジタル画像の特徴量を算出する。検索手段１６は、算出した特徴量と、データベース１８中に格納されている特徴量とを比較し、合致する特徴量に対応する画像情報を見つけだす。さらに、検索手段１６は、見つけだした画像情報の属性情報である作者名、絵画の名称等をデータベース１８から読み出し、出力手段２０に送出する。出力手段２０は、供給されてきた作者名、絵画の名称等を表示手段２２に表示させる。このようにして、利用者は絵画の名称や作者名を容易に知ることができる。

CDX-0005

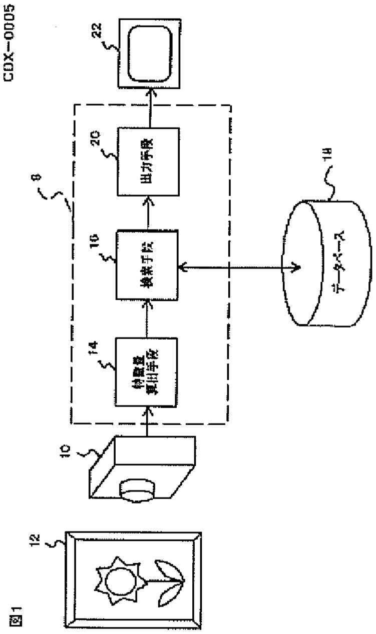


図1

【特許請求の範囲】

【請求項１】　与えられた入力画像情報の特徴量を算出する特徴量算出手段と、
前記算出した特徴量と合致する特徴量を有する画像情報を、データベースから検索し、この検索によって見いだされた画像情報が表す物体の属性情報を、前記データベースから読み出す検索手段と、
前記読み出した属性情報を出力する属性情報出力手段と、
を含むことを特徴とする画像識別装置。

【請求項２】　画像情報と、前記画像情報が表す物体の属性情報と、前記画像情報の特徴量と、を格納するデータベースと、
与えられた入力画像情報の特徴量を算出する特徴量算出手段と、
前記算出した特徴量と合致する特徴量を有する画像情報を、前記データベースから検索し、この検索によって見いだされた画像情報が表す物体の属性情報を、前記データベースから読み出す検索手段と、
前記読み出した属性情報を出力する属性情報出力手段と、
を含むことを特徴とする画像識別装置。

【請求項３】　請求項１又は２記載の画像識別装置において、
物体の画像情報を生成するディジタルカメラ手段、
を備え、前記ディジタルカメラ手段が、前記入力画像情報を生成することを特徴とする画像識別装置。

【請求項４】　請求項１又は２記載の画像識別装置において、
前記物体は、美術品であり、前記属性情報には、少なくとも前記美術品の作者名及び作品名が含まれていることを特徴とする画像識別装置。

【請求項５】　請求項４記載の画像識別装置において、
前記物体は、絵画であり、前記属性情報には、少なくとも前記絵画の作者名及び作品名が含まれていることを特徴とする画像識別装置。

【請求項６】　請求項１又は２記載の画像識別装置において、
前記物体は、衣服であり、前記属性情報には、少なくとも前記衣服のブランド名が含まれていることを特徴とする画像識別装置。

【請求項７】　請求項６記載の画像識別装置において、
前記物体は、ネクタイであり、前記画像情報は、前記ネクタイの柄を表す画像情報であることを特徴とする画像識別装置。

【請求項８】　請求項１又は２記載の画像識別装置において、
前記物体は、植物であり、前記属性情報には、少なくとも前記植物の名称及び分類が含まれていることを特徴とする画像識別装置。

【請求項９】　請求項１又は２記載の画像識別装置において、
前記物体は、動物であり、前記属性情報には、少なくとも前記動物の名称及び分類が含まれていることを特徴とする画像識別装置。

【請求項１０】　請求項９記載の画像識別装置において、
前記物体は、魚類であり、前記属性情報には、少なくとも前記魚類の名称及び分類が含まれていることを特徴とする画像識別装置。

【請求項１１】　請求項１０記載の画像識別装置において、
前記特徴量には、少なくとも前記魚類の目の色に重点を置いた鮮度特徴量が含まれており、
前記データベースにはある種の前記魚類に関して、前記鮮度特徴量が異なる複数のエントリーが含まれていることを特徴とする画像識別装置。

【請求項１２】　請求項１又は２記載の画像識別装置において、
前記物体は、食品であり、前記属性情報には、少なくとも前記食品の名称が含まれていることを特徴とする画像識別装置。

【請求項１３】　与えられた入力画像情報の特徴量を算出する特徴量算出手段と、
前記算出した特徴量と合致する特徴量を有する画像情報を、データベースから検索し、この検索によって見いだされた画像情報が表す状態の属性情報を、前記データベースから読み出す検索手段と、
前記読み出した属性情報を出力する属性情報出力手段と、
を含むことを特徴とする画像識別装置。

【請求項１４】　画像情報と、前記画像情報が表す状態の属性情報と、前記画像情報の特徴量と、を格納するデータベースと、
与えられた入力画像情報の特徴量を算出する特徴量算出手段と、
前記算出した特徴量と合致する特徴量を有する画像情報を、前記データベースから検索し、前記検索によって見いだされた画像情報が表す状態の属性情報を、前記データベースから読み出す検索手段と、
前記読み出した属性情報を出力する属性情報出力手段と、
を含むことを特徴とする画像識別装置。

【請求項１５】　請求項１３又は１４記載の画像識別装置において、
所定の状態を表す画像情報を生成するディジタルカメラ手段、
を備え、前記ディジタルカメラ手段が、前記入力画像情報を生成することを特徴とする画像識別装置。

【請求項１６】　請求項１３又は１４記載の画像識別装

置において、
前記状態は、靴の足跡を表す地表面、路面又は床面の状態であり、前記属性情報には少なくともその靴の製造会社名が含まれていることを特徴とする画像識別装置。
【請求項１７】　請求項１３又は１４記載の画像識別装置において、
前記状態は、医療検査結果であり、前記属性情報には少なくとも診断結果が含まれていることを特徴とする画像識別装置。
【請求項１８】　請求項１７記載の画像識別装置において、
前記画像情報は、レントゲン写真を表す画像情報であることを特徴とする画像識別装置。
【請求項１９】　物体を表す画像情報と、前記画像情報が表す物体の属性情報と、前記画像情報の特徴量と、を格納する記憶手段と、
前記特徴量をキーとして前記画像情報を検索する検索手段と、
を含むことを特徴とするデータベースシステム。
【請求項２０】　状態を表す画像情報と、前記画像情報が表す状態の属性情報と、前記画像情報の特徴量と、を格納する記憶手段と、
前記特徴量をキーとして前記画像情報を検索する検索手段と、
を含むことを特徴とするデータベースシステム。
【請求項２１】　物体を表す画像情報と、前記画像情報が表す物体の属性情報と、前記画像情報の特徴量と、を格納したことを特徴とする記録媒体であって、前記特徴量をキーとして前記画像情報を検索しうることを特徴とするコンピュータ読み取り可能な記録媒体。
【請求項２２】　状態を表す画像情報と、前記画像情報が表す状態の属性情報と、前記画像情報の特徴量と、を格納したことを特徴とする記録媒体であって、前記特徴量をキーとして前記画像情報を検索しうることを特徴とするコンピュータ読み取り可能な記録媒体。
【請求項２３】　請求項１、２、１３又は１４記載の画像識別装置において、
所定の記録媒体から前記入力画像情報を読み出す記録媒体読み出し手段、
を備え、前記特徴量算出手段は、前記記録媒体から読み出した前記入力画像情報の特徴量を算出することを特徴とする画像識別装置。
【請求項２４】　請求項２３記載の画像識別装置において、
前記記録媒体は、ディジタルカメラ手段によって画像情報を書き込まれることが可能な記録媒体であることを特徴とする画像識別装置。
【請求項２５】　請求項１、２、１３又は１４記載の画像識別装置において、
所定の通信回線から前記入力画像情報を受信する画像受信手段、
を備え、前記特徴量算出手段は、前記画像受信手段が受信した前記入力画像情報の特徴量を算出することを特徴とする画像識別装置。
【請求項２６】　請求項２５記載の画像識別装置において、
前記属性情報出力手段が出力した属性情報を、前記通信回線を介して送信する属性情報送信手段、
を含むことを特徴とする画像識別装置。
【請求項２７】　請求項２５記載の画像識別装置において、
前記画像受信手段は、
前記通信回線から電子メールを受信し、その電子メールに含まれる前記入力画像情報を抽出する電子メール受信手段、
を含むことを特徴とする画像識別装置。
【請求項２８】　請求項２６記載の画像識別装置において、
前記画像送信手段は、
前記属性情報出力手段が出力した属性情報を含む電子メールを、前記通信回線を介して送信する電子メール送信手段、
を含むことを特徴とする画像識別装置。
【請求項２９】　請求項２５、２６、２７又は２８記載の画像識別装置において、
前記通信回線はインターネットであることを特徴とする画像識別装置。
【請求項３０】　請求項２５記載の画像識別装置において、
前記通信回線は移動体通信回線であり、
前記画像受信手段は、
前記移動体通信回線を介して、ディジタルカメラ手段から前記入力画像情報を受信する移動体端末受信手段、を含むことを特徴とする画像識別装置。
【請求項３１】　請求項２６記載の画像識別装置において、
前記通信回線は、移動体通信端末によって通信を行う移動体通信回線であり、
前記画像送信手段は、
前記属性情報出力手段が出力した属性情報を、前記移動体通信回線を介して相手方の前記移動体通信端末に送信する移動体端末送信手段、
を含むことを特徴とする画像識別装置。
【請求項３２】　請求項３０又は３１記載の画像識別装置において、
前記移動体通信回線は、携帯電話通信回線であることを特徴とする画像識別装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、画像識別装置に関

する。特に、絵画等の画像を取得し、その絵画の作者等を知ることができる画像識別装置に関する。また、この画像識別装置が利用するデータ構造を有する記録媒体、及びこの画像識別装置が利用するデータベースシステムに関する。

【０００２】

【従来の技術】近年、絵画等の美術品をディジタル情報で保存しようとするいわゆるディジタルアーカイブ事業が広く行われている。このように美術品をディジタル情報で保存することにより、実物と異なり、半永久的な保存が可能となる。また、このような美術品のデータベースを作成することによって、例えば、作品名からその美術品を瞬時に表示することも可能となり、美術品に関する教育・研究に寄与すると考えられている。

【０００３】

【発明が解決しようとする課題】このようなディジタルアーカイブ事業による美術品のデータベースによれば、作品名、作者名等から美術品を瞬時に検索することができるが、逆に、絵画等の画像情報からその作者名や作品名を知ること、すなわちデータベースの逆引きは困難であった。

【０００４】また、植物図鑑等においても、植物の品種名からその植物の絵を検索する索引は存在しても、植物の画像（絵）からその植物の品種名を知ることは困難であった。

【０００５】例えば、野外等に存在する植物の品種名を知りたい場合に、植物の画像から、その植物の品種名がわかるシステムが存在すれば、教育・研究に大きく資することは容易に予想できる。

【０００６】美術品に関しても、その絵画等の画像に基づき、その作品名や作者名がわかれば教育・研究に大きく寄与することは想像に難くない。

【０００７】しかしながら、従来、画像情報に基づき、その画像情報が表す物体（植物、美術品）の属性（品種名、作者名）を知ることができるシステム、ひいてはデータベースは知られていない。

【０００８】本発明は、かかる課題に鑑みなされたものであり、その目的は、美術品等の画像情報に基づき、その画像情報が表す物体の作者等の属性情報を知ることができるシステムを提供することである。

【０００９】

【課題を解決するための手段】第１の本発明は、上記課題を解決するために、与えられた入力画像情報の特徴量を算出する特徴量算出手段と、前記算出した特徴量と合致する特徴量を有する画像情報を、データベースから検索し、この検索によって見いだされた画像情報が表す物体の属性情報を、前記データベースから読み出す検索手段と、前記読み出した属性情報を出力する属性情報出力手段と、を含むことを特徴とする画像識別装置である。

【００１０】このような構成によれば、特徴量を用いて

検索しているため、画像情報が表す物体の属性情報を効率的に得ることができる。

【００１１】第２の本発明は、画像情報と、前記画像情報が表す物体の属性情報と、前記画像情報の特徴量と、を格納するデータベースと、与えられた入力画像情報の特徴量を算出する特徴量算出手段と、前記算出した特徴量と合致する特徴量を有する画像情報を、前記データベースから検索し、この検索によって見いだされた画像情報が表す物体の属性情報を、前記データベースから読み出す検索手段と、前記読み出した属性情報を出力する属性情報出力手段と、を含むことを特徴とする画像識別装置である。

【００１２】このような構成によればデータベースを含んでいるため、外部のデータベースにアクセスする必要がない。

【００１３】第３の本発明は、物体の画像情報を生成するディジタルカメラ手段、を備え、前記ディジタルカメラ手段が、前記入力画像情報を生成することを特徴とする画像識別装置である。

【００１４】物体の画像を生成するためにディジタルカメラ手段を備えているため、眼前にある物体に基づき、迅速に画像情報を生成することができ、その物体の属性情報を迅速に得ることができる。

【００１５】第４の本発明は、前記物体は、美術品であり、前記属性情報には、少なくとも前記美術品の作者名及び作品名が含まれていることを特徴とする画像識別装置である。

【００１６】このような構成によれば、美術品の作者名等を迅速に知ることができる。

【００１７】第５の本発明は、前記物体は、絵画であり、前記属性情報には、少なくとも前記絵画の作者名及び作品名が含まれていることを特徴とする画像識別装置。

【００１８】このような構成によれば、絵画の作品名等を迅速に知ることができる。

【００１９】第６の本発明は、前記物体は、衣服であり、前記属性情報には、少なくとも前記衣服のブランド名が含まれていることを特徴とする画像識別装置である。

【００２０】このような構成によれば、衣服のブランド名等を迅速に知ることができる。

【００２１】第７の本発明は、前記物体は、ネクタイであり、前記画像情報は、前記ネクタイの柄を表す画像情報であることを特徴とする画像識別装置である。

【００２２】このような構成によれば、ネクタイの柄に基づき、ネクタイのブランド名等を迅速に知ることができる。

【００２３】第８の本発明は、前記物体は、植物であり、前記属性情報には、少なくとも前記植物の名称及び分類が含まれていることを特徴とする画像識別装置であ

る。
【００２４】このような構成によれば、植物の名称等を迅速に知ることができる。
【００２５】第９の本発明は、前記物体は、動物であり、前記属性情報には、少なくとも前記動物の名称及び分類が含まれていることを特徴とする画像識別装置である。
【００２６】このような構成によれば、動物の名称等を迅速に知ることができる。
【００２７】第１０の本発明は、前記物体は、魚類であり、前記属性情報には、少なくとも前記魚類の名称及び分類が含まれていることを特徴とする画像識別装置である。
【００２８】このような構成によれば、魚類の名称等を迅速に知ることができる。
【００２９】第１１の本発明は、前記特徴量には、少なくとも前記魚類の目の色に重点を置いた鮮度特徴量が含まれており、前記データベースにはある種の前記魚類に関して、前記鮮度特徴量が異なる複数のエントリーが含まれていることを特徴とする画像識別装置。
【００３０】このような構成によれば、魚類の鮮度を識別可能である。
【００３１】第１２の本発明は、前記物体は、食品であり、前記属性情報には、少なくとも前記食品の名称が含まれていることを特徴とする画像識別装置である。
【００３２】このような構成によれば、食品の鮮度を識別可能である。
【００３３】第１３の本発明は、与えられた入力画像情報の特徴量を算出する特徴量算出手段と、前記算出した特徴量と合致する特徴量を有する画像情報を、データベースから検索し、この検索によって見いだされた画像情報が表す状態の属性情報を、前記データベースから読み出す検索手段と、前記読み出した属性情報を出力する属性情報出力手段と、を含むことを特徴とする画像識別装置である。
【００３４】このような構成によれば、特徴量を用いて検索しているため、画像情報が表す状態の属性情報を効率的に得ることができる。
【００３５】第１４の本発明は、画像情報と、前記画像情報が表す状態の属性情報と、前記画像情報の特徴量と、を格納するデータベースと、与えられた入力画像情報の特徴量を算出する特徴量算出手段と、前記算出した特徴量と合致する特徴量を有する画像情報を、前記データベースから検索し、前記検索によって見いだされた画像情報が表す状態の属性情報を、前記データベースから読み出す検索手段と、前記読み出した属性情報を出力する属性情報出力手段と、を含むことを特徴とする画像識別装置である。
【００３６】このような構成によればデータベースを含んでいるため、外部のデータベースにアクセスする必要がない。
【００３７】第１５の本発明は、所定の状態を表す画像情報を生成するディジタルカメラ手段、を備え、前記ディジタルカメラ手段が、前記入力画像情報を生成することを特徴とする画像識別装置である。
【００３８】状態を表す画像を生成するためにディジタルカメラ手段を備えているため、眼前にある状態に基づき、迅速に画像情報を生成することができ、その状態の属性情報を迅速に得ることができる。
【００３９】第１６の本発明は、前記状態は、靴の足跡を表す地表面、路面又は床面の状態であり、前記属性情報には少なくともその靴の製造会社名が含まれていることを特徴とする画像識別装置である。
【００４０】このような構成によれば、靴の足跡に関し、その靴の製造会社名を迅速に知ることができる。
【００４１】第１７の本発明は、前記状態は、医療検査結果であり、前記属性情報には少なくとも診断結果が含まれていることを特徴とする画像識別装置である。
【００４２】このような構成によれば、医療の検査結果に基づき、診断結果を迅速に知ることができる。
【００４３】第１８の本発明は、前記画像情報は、レントゲン写真を表す画像情報であることを特徴とする画像識別装置である。
【００４４】このような構成によれば、レントゲン写真に基づき、診断結果を迅速に知ることができる。
【００４５】第１９の本発明は、物体を表す画像情報と、前記画像情報が表す物体の属性情報と、前記画像情報の特徴量と、を格納する記憶手段と、前記特徴量をキーとして前記画像情報を検索する検索手段と、を含むことを特徴とするデータベースシステムである。
【００４６】このようなデータベースシステムによれば、外部からの入力画像情報を含む問い合わせによって、その画像情報が表す物体の属性情報を知ることができる。
【００４７】第２０の本発明は、状態を表す画像情報と、前記画像情報が表す状態の属性情報と、前記画像情報の特徴量と、を格納する記憶手段と、前記特徴量をキーとして前記画像情報を検索する検索手段と、を含むことを特徴とするデータベースシステムである。
【００４８】このようなデータベースシステムによれば、外部からの入力画像情報を含む問い合わせによって、その画像情報が表す状態の属性情報を知ることができる。
【００４９】第２１の本発明は、物体を表す画像情報と、前記画像情報が表す物体の属性情報と、前記画像情報の特徴量と、を格納したことを特徴とする記録媒体であって、前記特徴量をキーとして前記画像情報を検索しうることを特徴とするコンピュータ読み取り可能な記録媒体である。
【００５０】このようなデータ構造を有する記憶媒体に

よれば、画像情報の特徴量に基づき、画像情報を検索し、さらに、その画像情報が表す物体の属性情報を得ることができる。

【００５１】第２２の本発明は、状態を表す画像情報と、前記画像情報が表す状態の属性情報と、前記画像情報の特徴量と、を格納したことを特徴とする記録媒体であって、前記特徴量をキーとして前記画像情報を検索しうることを特徴とするコンピュータ読み取り可能な記録媒体である。

【００５２】このようなデータ構造を有する記憶媒体によれば、画像情報の特徴量に基づき、画像情報を検索し、さらに、その画像情報が表す状態の属性情報を得ることができる。

【００５３】第２３の本発明は、所定の記録媒体から前記入力画像情報を読み出す記録媒体読み出し手段、を備え、前記特徴量算出手段は、前記記録媒体から読み出した前記入力画像情報の特徴量を算出することを特徴とする画像識別装置である。

【００５４】このような構成によれば、画像が格納された記録媒体に基づいて、画像識別が可能な画像識別装置が得られる。

【００５５】第２４の本発明は、前記記録媒体は、ディジタルカメラ手段によって画像情報を書き込まれることが可能な記録媒体であることを特徴とする画像識別装置である。

【００５６】このような構成によれば、まず、ディジタルカメラで画像を撮影し、記録媒体に格納し、次に、この画像が格納された記録媒体に基づいて、画像識別をすることが可能である。

【００５７】第２５の本発明は、所定の通信回線から前記入力画像情報を受信する画像受信手段、を備え、前記特徴量算出手段は、前記画像受信手段が受信した前記入力画像情報の特徴量を算出することを特徴とする画像識別装置である。

【００５８】このような構成によれば、通信回線を介して送信されてきた入力画像情報について、画像識別をすることが可能である。

【００５９】第２６の本発明は、前記属性情報出力手段が出力した属性情報を、前記通信回線を介して送信する属性情報送信手段、を含むことを特徴とする画像識別装置である。

【００６０】このような構成によれば、画像識別の結果である属性情報を通信回線を介して送信することができ、遠隔地から画像識別装置を利用可能である。

【００６１】第２７の本発明は、前記画像受信手段は、前記通信回線から電子メールを受信し、その電子メールに含まれる前記入力画像情報を抽出する電子メール受信手段、を含むことを特徴とする画像識別装置である。

【００６２】このような構成によれば、電子メールに含まれる入力画像情報について、画像識別をすることが可能である。

【００６３】第２８の本発明は、前記画像送信手段は、前記属性情報出力手段が出力した属性情報を含む電子メールを、前記通信回線を介して送信する電子メール送信手段、を含むことを特徴とする画像識別装置である。

【００６４】このような構成によれば、画像識別の結果である属性情報を電子メールで送信することができ、遠隔地から画像識別装置を利用可能である。

【００６５】第２９の本発明は、前記通信回線はインターネットであることを特徴とする画像識別装置である。

【００６６】インターネットを通信回線として用いたので、インターネットにアクセス可能な場所から、画像識別装置を利用可能である。

【００６７】第３０の本発明は、前記通信回線は移動体通信回線であり、前記画像受信手段は、前記移動体通信回線を介して、ディジタルカメラ手段から前記入力画像情報を受信する移動体端末受信手段、を含むことを特徴とする画像識別装置である。

【００６８】このような構成によれば、移動体通信回線を介して受信した入力画像情報に基づき、画像識別を行うことができる。

【００６９】第３１の本発明は、前記通信回線は、移動体通信端末によって通信を行う移動体通信回線であり、前記画像送信手段は、前記属性情報出力手段が出力した属性情報を、前記移動体通信回線を介して相手方の前記移動体通信端末に送信する移動体端末送信手段、を含むことを特徴とする画像識別装置である。

【００７０】このような構成によれば、画像識別の結果である属性情報を移動体通信端末で受信することができ、遠隔地から画像識別装置が生成した属性情報を知ることができる。

【００７１】第３２の本発明は、前記移動体通信回線は、携帯電話通信回線であることを特徴とする画像識別装置である。

【００７２】携帯電話通信回線を用いて入力画像情報や属性情報を送受信するので、携帯電話を利用可能な場所から、画像識別装置を利用可能である。

【００７３】

【発明の実施の形態】以下、本発明の好適な実施の形態を図面に基づいて説明する。

【００７４】実施の形態１

図１には、本発明の好適な実施の形態１にかかる画像識別装置８の構成ブロック図が示されている。

【００７５】この図に示されているように、画像識別装置８は特徴量算出手段１４と、検索手段１６と、出力手段２０とから構成されている。

【００７６】まず、ディジタルカメラ１０が絵画１２を撮影し、その絵画のディジタル画像を生成する。生成したディジタル画像は特徴量算出手段１４に送出される。特徴量算出手段１４は絵画のディジタル画像の特徴量を

算出する。

【００７７】次に、検索手段１６は、算出した特徴量と、データベース１８中に格納されている特徴量とを比較し、合致する特徴量に対応する画像情報を見つけだす。この画像情報は絵画の画像情報である。

【００７８】さらに、検索手段１６は、見つけだした画像情報の属性情報である作者名、絵画の名称等をデータベース１８から読み出し、出力手段２０に送出する。出力手段２０は、供給されてきた作者名、絵画の名称等を表示手段２２に表示させる。

【００７９】このようにして、本実施の形態１によれば、絵画をディジタルカメラ１０で撮影することによって、その絵画の作者や絵画の名称等が表示手段２２に示される。したがって、利用者は絵画の名称や作者名を容易に知ることができる。

【００８０】さて、本実施の形態１において特徴的なことは、画像情報をデータベース１８から検索する際に特徴量を用いていることである。画像の特徴量としては、従来から知られている種々の特徴量を用いることができる。

【００８１】このような種々の特徴量を特徴量算出手段１４が算出するのである。特徴量そのものは、従来から知られているものであるため、その算出方法の説明は省略する。

【００８２】また、データベース１８は、絵画に関するデータベースである。このデータベース１８には、絵画の画像情報と、その絵画の属性情報と、その画像情報の特徴量とが格納されている。属性情報とは、その絵画の作者名や絵画の名称等である。また、データベース１８は、特徴量をキーとして絵画の画像情報を検索しやすくするために、特徴量に関するインデックステーブルが設けられている。これによって、特徴量をキーとして画像の情報を迅速に検索することが可能なデータ構造がデータベース１８中に実現されている。

【００８３】本実施の形態１においては、検索手段１６は、特徴量をキーとして検索した画像情報に関し、その属性情報をデータベース１８から読み出す。そして、検索手段１６は、読み出した属性情報、すなわち作者名等を表示手段２２に供給する。表示手段２２は、この作者名等の表示を行う。

【００８４】データベース１８は種々の形態をとることができる。例えばコンピュータのハードディスク上に構成されていてもよい。また、例えばこの種の絵画のデータベースは美術館等に設置される場合も多いと考えられる。そのような場合には、画像識別装置８は、データベース１８から遠距離に存在することも多い。この場合は、画像識別装置８を通信回線を介してデータベース１８と接続する形態を採用することが好ましい。このように通信回線を介して画像識別装置８と接続するのに適したデータベースシステムの構成は後の実施の形態３においてさらに詳述する。

【００８５】なお、属性情報としては、作者名や絵画の名称の他に、その絵画の制作年、所有者、サイズ、専門家による評論・説明等を利用することも好ましい。専門家による評論・説明等を属性情報として表示手段２２に表示すれば、利用者はその絵画の説明を見ることができ、学習・教育等の目的に資することができる。

【００８６】また、上の説明では、絵画のディジタル画像はディジタルカメラ１０で生成したが、絵画の写真をスキャナーでスキャンすることによって絵画のディジタル画像を得ることも好ましい。また、ビデオ信号から絵画の静止画を取り込むように構成してもかまわない。いずれにしても、絵画のディジタル画像が得られればどのような手法を採用してもかまわない。

【００８７】また、上の説明では、データベース１８を画像識別装置８と別体に構成したが、画像識別装置８の内部に含めてもかまわない。識別の対象となる絵画の種類が少なく、データベース１８が小規模である場合には、画像識別装置内部のハードディスク等に、このデータベース１８を構成する形態が好ましい。

【００８８】また、表示装置２２は種々の表示装置を利用可能である。従来から用いられてきたＣＲＴや液晶表示装置など種々の表示装置が利用できる。さらに、上記説明では、表示装置２２を画像識別装置８と別体に構成したが、画像識別装置８の内部に含めてもかまわない。この場合、小型の液晶表示装置を画像識別装置８に備えさせれば、携帯に便利な小型化された画像識別装置も実現できる可能性がある。

【００８９】なお、特徴量算出手段１４は、計算専用のハードウェアを用いることも好ましいが、ソフトウェアで実現することも好ましい。また、検索手段１６は、データベース１８にアクセスするためのソフトウェアで構成することが望ましい。さらに、出力手段は、外部の表示手段２２の種類にも依存するが、例えばビデオカードとそのビデオカードを駆動するソフトウェアで構成することが望ましい。

【００９０】実施の形態２（応用分野）

上記説明では、絵画の例について説明したが、絵画に限らず、ディジタルカメラ等で撮影できる物体ならば、他の美術品や、動植物、衣服等でもかまわない。

【００９１】２．１

美術品としては、絵画の他に彫刻等が考えられる。この場合は、データベース１８は、彫刻の画像情報、彫刻の画像情報の特徴量、彫刻の属性情報（彫刻の作者、彫刻の名称）を含むデータベースである。

【００９２】２．２

物体が植物の場合は、植物の画像に基づき、その植物の名称や種類を知ることができる植物図鑑として利用することが可能である。この場合は、データベース１８は、植物の画像情報、植物の画像情報の特徴量、植物の属性

情報を含むデータベースである。植物の属性情報には、その植物の名称や、学名、科、生態、繁殖地域、１年草か２年草か、等が含まれる。

【００９３】2．3

物体が動物の場合も、植物とほぼ同様であり、動物の画像情報に基づき、その動物の名称や生態等を知ることができる。

【００９４】また、その動物が食用の魚類である場合には、特に特徴量として魚の目の色に重点を置いたものを採用することが好ましい。これは、魚の鮮度を表す指標として魚の目の色が広く利用されていることに基づくものである。このような場合、データベース１８は、１種類の魚に対して、鮮度が異なる複数のエントリーを有するものとなる。例えば、ある魚の鮮度が高い画像情報に関しては、鮮度が高いある魚の画像情報、鮮度が高いある魚の画像情報の特徴量、鮮度が高いという情報を含むある魚の属性情報、を含むエントリーがデータベース１８中に格納されている。

【００９５】そして、ある魚の鮮度が低い画像情報に関しては、鮮度が低いある魚の画像情報、鮮度が低いある魚の画像情報の特徴量、鮮度が低いという情報を含むある魚の属性情報、を含むエントリーがデータベース１８中に格納されている。

【００９６】このように、単一の種類の物体に対して、鮮度の異なる複数のエントリーがデータベース１８中に含まれている。このようにデータベース１８を構築することによって、単にその魚の画像情報に基づいて、魚の名称を知ることができるだけでなく、その魚の鮮度も知ることができるという効果がある。

【００９７】2．4

上記２．３においては、魚の鮮度を知ることができる画像識別装置について説明したが、同様の原理を用いて、一般の食品の鮮度を知ることができる画像識別装置を構成することも好ましい。

【００９８】この場合、データベース１８は、魚の場合と同様に、１種類の食品に対して、鮮度が異なる複数のエントリーを有するものとなる。例えば、ある食品の鮮度が高い画像情報に関しては、鮮度が高いある食品の画像情報、鮮度が高いある食品の画像情報の特徴量、鮮度が高いという情報を含むある食品の属性情報、を含むエントリーがデータベース１８中に格納されている。

【００９９】同様に、データベース１８中には、ある食品の鮮度が低い画像情報に関するエントリーも格納されている。

【０１００】このようなデータベース１８を用いることによって、食品の鮮度も知ることができる画像識別装置が構成可能である。

【０１０１】2．5

物体が衣服の場合も、美術品等と同様であり、衣服の画像情報に基づき、その衣服のブランド名称や織り方の種類等を知ることができる。この場合は、データベース１８は、衣服の画像情報、衣服の画像情報の特徴量、衣服の属性情報を含むデータベースである。衣服の属性情報には、その衣服のブランド名や、繊維の種類、織り方、洗濯方法、価格等が含まれる。

【０１０２】特に、衣服がネクタイやスカーフの場合には、その形状よりも、むしろ図柄から識別できる場合が多い。そのため、ネクタイ等の場合には画像情報としてネクタイの一部を採用することが好ましい。そして、その図柄の画像情報に基づき、画像の特徴量や、その図柄を有するネクタイ等の属性情報、がデータベース１８に格納されているのである。

【０１０３】2．6

以上説明してきた例では、ある独立した１個の物体を表す画像情報を利用し、その物体の属性情報を得ている。しかし、画像情報を生成することができれば、物体そのものではなく、物体の「跡」や物体の様子等の「状態」でもよく、そのような状態を表す画像情報を用いて、その状態に関する属性情報を得ることも好ましい。

【０１０４】例えば、足跡等の物体の跡もディジタルカメラ１０等を用いることによって、足跡の画像情報を生成することができる。そして、その足跡に基づき、足跡を作った靴の属性情報を表示しうる画像識別装置８を構成することも好ましい。なお、ここで、足跡とは、地表の靴の跡や、路上や床の上の靴の跡である。

【０１０５】なお、靴の属性情報としては、その靴の製造会社名や、靴の材質等を利用することが好ましい。

【０１０６】また、「物体の様子」としては、例えばレントゲン写真画像等の検査結果が挙げられる。レントゲン写真の画像情報に関し、その特徴点に基づき合致する画像をデータベース１８から検索することによって、そのレントゲン写真の属性情報を表示することができる。

【０１０７】属性情報としては、そのレントゲン写真に対する診断結果が好ましい。属性情報として診断結果が表示されることによって、いわば自動診断装置を構成することが可能である。

【０１０８】ここでは、レントゲン写真について説明したが、内視鏡写真等、画像で表現できるものであればどのような検査の結果でもかまわない。

【０１０９】実施の形態３（データベースシステム）

以上述べた説明においては、画像識別装置８は、特定のデータ構造を有するデータベース１８を利用していた。このデータベース１８は、既に述べたように、各エントリー中に、物体の画像情報と、その物体の画像情報の特徴量と、その物体の属性情報と、を含むことを特徴とするものである。また、既に述べたように、データベース１８は、各エントリー中に、状態の画像情報と、その状態の画像情報の特徴量と、その状態の属性情報と、を含むことをも特徴とするものである。

【０１１０】さて、一般に美術品等のデータベースは、

美術館等に置かれて管理される場合が多い。したがって、上述したように画像識別装置８とデータベース１８とは通信回線で接続される場合も多いと考えられる。

【０１１１】この場合には、データベース８を単なる記憶手段としてではなく、検索機能も備えたデータベースシステム３０として構築するのが好ましい。これは、通信回線上のトラフィック量の軽減のためである。このようなデータベースシステム３０の構成ブロック図が図２に示されている。

【０１１２】データベース１８の代わりに、データベースシステム３０を用いる場合は、図１の検索手段１６は、データベースシステム３０に対し問い合わせ（クエリー）を発し、データベース管理手段３２がこの問い合わせ（クエリー）に応答してデータベース１８を検索して結果を検索手段１６に返送する。このような構成によれば、検索結果だけが通信回線状を流れるのでトラフィック量の軽減を図ることができる。なお、データベース管理手段３２は、コンピュータのソフトウェアで実現することが好ましい。

【０１１３】また、データベースシステム３０が美術館等に設置された場合は、上述した画像識別装置８を用いずに、利用者が手作業でその絵画等の名称を知ることも可能である。

【０１１４】すなわち、利用者はまず、ディジタルカメラ１０等を用いて美術品の撮影をして画像情報を得る。次に、利用者は画像情報の特徴量を算出し、この特徴量と合致する画像情報をデータベース１８中から見つけるようにデータベースシステム３０に通信回線を介して依頼する。この依頼に基づき、データベースシステム３０のデータベース管理手段３２は対応する画像情報を検索し、その画像情報の属性情報である名称や作品名を利用者に送信するのである。利用者は通信回線を介して美術品の作品名や作者名を受信することによって、その美術品の属性を知ることができる。

【０１１５】以上のような構成のデータベースシステム３０は、美術品のデータベースだけでなく、上述した医療診断にも用いることができる。この場合にはそのデータベースシステム３０は例えば病院等に設置されることになろう。その結果、遠隔地にいる被検者に対していわゆる遠隔診断が可能となる。

【０１１６】実施の形態４（記録媒体）

以上述べた実施の形態においては、特別なデータ構造を有するデータベース１８を利用することを前提としていた。図３には、このデータベース１８のデータ構造が示されている。既に述べたように、このデータベース１８は、ある物体の画像情報と、その画像情報の特徴量と、その物体の属性情報と、を含んでいる。なお、図３には示していないが、データベース１８は、ある状態の画像情報と、その画像情報の特徴量と、その状態の属性情報と、を含む構成でもよいことは上述の通りである。

【０１１７】このような特別なデータ構造を記録媒体に格納することによって、データベースが構築されている。したがって、特徴量を用いて画像情報の検索をすることができるのである。なお、検索をより高速にするために、特徴量に関するインデックステーブルを構築することも好ましい（図３参照）。

【０１１８】なお、記録媒体としては、コンピュータ読み取り可能な記録媒体であればどのようなものでもかまわない。例えば、フロッピー（登録商標）ディスクでもかまわないし、ハードディスクやＣＤＲＯＭ等を利用することも好ましい。

【０１１９】このようにコンピュータ読み取り可能な記録媒体中にデータベース１８を構成させれば、コンピュータを用いて画像識別装置を容易に構成できる。また、そのコンピュータの利用者が記録媒体中のデータベース１８にアクセスすることによって、画像情報に基づき、その画像情報が表す物体や状態の属性情報を得ることも可能である。

【０１２０】実施の形態５（入力画像情報の取得形態）

以上述べた実施の形態においては、入力画像情報は図１に示されているように外部のディジタルカメラ１０等から直接供給されていた。

【０１２１】しかし、ディジタルカメラ１０と画像識別装置８とを直接接続しなくても、通信回線を介して画像情報を供給することも好ましい。また、画像情報を一旦記録媒体に格納し、この記録媒体を画像識別装置に供給する形態を採用することも好ましい。

【０１２２】以下、本実施の形態５においては、入力画像情報を画像識別装置に供給する種々の形態について説明する。

【０１２３】図４には本実施の形態５にかかる画像識別装置３８は、図１と同様に、特徴量算出手段１４と、検索手段１６、出力手段２０を備えている。また、表示手段２２が出力手段２０に接続され、データベース１８が検索手段に接続されている。これらの構成は上記実施の形態１と同様の動作を行っている。

【０１２４】５．１

本実施の形態５において特徴的なことは、記録媒体読み取り手段４０が特徴量算出手段１４に接続されていることである。この記録媒体読み取り手段４０は、コンパクトフラッシュやスマートメディア等の記録媒体から入力画像情報を読み取り、特徴量算出手段１４に供給する。特徴量算出手段１４は、供給された入力画像情報に基づき特徴量を算出するのである。

【０１２５】このような構成によれば、ディジタルカメラ１０を直接画像識別装置３８に接続しなくても、入力画像情報を画像識別装置３８に供給することができる。

【０１２６】すなわち、利用者はまず、ディジタルカメラ１０等を用いて画像を撮影し、入力画像情報を得る。この入力画像情報は上述したコンパクトフラッシュ等の

記録媒体に格納される。一般にディジタルカメラ１０等はこのようなコンパクトフラッシュやスマートメディア等の記録媒体に画像を格納する機能を有している。

【０１２７】利用者は、このようにして画像を格納した記録媒体を、画像識別装置３８の記録媒体読み取り手段４０に読み取らせる。記録媒体読み取り手段４０は、読み取った画像を入力画像情報として特徴量算出手段１４に供給する。以下の動作は上記実施の形態１と同様であり、利用者は、画像の識別の結果である属性情報等を表示手段２２の画面上で見ることができる。

【０１２８】このような動作によって、利用者は画像識別装置３８と離れた場所で画像を撮影することができる。

【０１２９】なお、記録媒体としては可搬性を有するものであれば種々のものを採用することができる。上述したコンパクトフラッシュの他、メモリースティックや、フロッピーディスク、ＣＤ－Ｒ等でも好ましい。また、リムーバブルハードディスクのような記録媒体でもかまわない。

【０１３０】ただし、本実施の形態５では、画像の格納のために記録媒体を用いているため、ディジタルカメラ１０等の画像取得手段が画像情報を書き込み可能な記録媒体であることが最も望ましい。

【０１３１】また、記録媒体読み取り手段４０は、コンパクトフラッシュやスマートメディア、メモリースティック等を読み書きするドライブ装置、及びこのドライブ装置を駆動するドライバプログラムで構成する事が好ましい。

【０１３２】５．２

さらに、本実施の形態５において特徴的なことは、電子メール通信手段４２が特徴量算出手段１４に接続されていることである。この電子メール通信手段４２は、インターネット等の通信回線を介して電子メールを受信する。そして、この電子メールに含まれている入力画像情報を抽出し、特徴量算出手段１４に供給する。特徴量算出手段１４は、供給された入力画像情報に基づき特徴量を算出するのである。

【０１３３】このような構成によれば、ディジタルカメラ１０を直接画像識別装置３８に接続しなくても、入力画像情報を画像識別装置３８に供給することができる。

【０１３４】すなわち、利用者はまず、ディジタルカメラ１０等を用いて画像を撮影し、撮影した入力画像情報を、その撮影した場所でノートパソコン等に格納する。次に、利用者はノートパソコン等の通信機能を利用し、得た入力画像情報を添付した電子メールを画像識別装置宛に送信する。

【０１３５】電子メール通信手段４２は、インターネット等の通信回線を介して送信されてきた電子メールを受信する。そして、この電子メールに添付されている上記入力画像情報を抽出し、特徴量算出手段１４に供給する。以下の動作は上記実施の形態１と同様であり、画像識別装置３８は、画像の識別の結果である属性情報等を得る。

【０１３６】さらに、本実施の形態５にかかる電子メール通信手段４２は、得た属性情報等を電子メールを使用して返信する機能を備えている。すなわち、電子メール通信手段４２は、検索手段１６が得た属性情報等を含む電子メールを、入力画像情報を送った相手先に返信するのである。利用者は、返信されてきた電子メールを見ることによって、属性情報等を知ることができる。

【０１３７】この結果、利用者は、画像識別装置３８から遠く離れた場所からでも画像識別装置３８の機能を利用することができ、利便性の高い画像識別装置３８が実現可能である。

【０１３８】なお、本発明の画像受信手段や属性情報送信手段は、本実施の形態５の電子メール通信手段４２に相当する。さらに、本発明の電子メール送信手段や電子メール受信手段も、本実施の形態５の電子メール通信手段４２に相当することは言うまでもない。

【０１３９】また、電子メール通信手段４２は、具体的にはモデム又はターミナルアダプタ等と、電子メールソフトウェアと、から構成することが好ましい。

【０１４０】５．３

上述した例ではインターネットを利用した電子メールによって、入力画像情報と属性情報を送受信する例を示した。しかし、入力画像情報と属性情報を送受信できれば、必ずしも電子メールを用いなくてもかまわない。

【０１４１】特に、近年のディジタルカメラ１０は高機能化され、携帯電話等を利用して遠隔地のパソコンと通信する機能を備えている場合も多い。このようなディジタルカメラ１０を用いる場合には、インターネットを介さずに移動体通信回線等の一般の公衆回線を介して入力画像情報と属性情報を送受信することも好ましい。

【０１４２】このようなことを実現するために、本実施の形態５では、移動体通信手段４４が特徴量算出手段１４に接続されている。この移動体通信手段４４は、携帯電話などの移動体通信回線を利用して入力画像情報や属性情報を送受信する手段である。そして、移動体通信手段４４は移動体通信回線を介して受信した入力画像情報を抽出し、特徴量算出手段１４に供給する。特徴量算出手段１４は、供給された入力画像情報に基づき特徴量を算出するのである。

【０１４３】このような構成によれば、ディジタルカメラ１０を直接画像識別装置３８に接続しなくても、入力画像情報を画像識別装置３８に供給することができる。

【０１４４】すなわち、利用者はまず、ディジタルカメラ１０等を用いて画像を撮影し、撮影した入力画像情報を、携帯電話による通信を利用して、得た入力画像情報を画像識別装置３８に送信する。

【０１４５】画像識別装置３８の移動体通信手段４４

は、移動体通信回線を介して送信されてきた入力画像情報を受信する。そして、この入力画像情報を、特徴量算出手段１４に供給する。以下の動作は上記実施の形態１と同様であり、画像識別装置３８は、画像の識別の結果である属性情報等を得る。

【０１４６】さらに、本実施の形態５にかかる移動体通信手段４４は、得られた属性情報等を移動体通信回線を介して携帯電話に返信する機能を備えている。すなわち、移動体通信手段４４は、検索手段１６が得た属性情報等を、入力画像情報を送った相手先に返信するのである。利用者は、返信されてきた属性情報等を携帯電話上で見ることによって、属性情報等を知ることができる。なお、近年の携帯電話は高機能化され、単なる電話機能だけでなく、各種の情報を表示する機能を有している。

【０１４７】この結果、利用者は、画像識別装置３８から遠く離れた場所からでも画像識別装置３８の機能を利用することができ、利便性の高い画像識別装置３８が実現可能である。

【０１４８】なお、本発明の画像受信手段や属性情報送信手段は、本実施の形態５の移動体通信手段４４に相当する。さらに、本発明の移動体端末受信手段や移動体端末送信手段も、本実施の形態５の移動体端末通信手段４４に相当することは言うまでもない。

【０１４９】また、移動体通信手段４４は、携帯電話と、携帯電話を利用してデータ通信を行うためのアダプタ等と、から構成することが好ましい。

【０１５０】

【発明の効果】以上述べたように、本発明によれば、画像の特徴量を利用して画像情報を検索し、その画像情報が表す物体や状態の属性情報を知ることができる。その結果、絵画などの美術品の画像情報に基づき、その絵画等の美術品の作品名や作者名を知ることができる画像識別装置が実現できる。

【０１５１】また、画像識別装置にデータベースを備えさせれば、外部のデータベースにアクセスせずに画像情報に基づき属性情報を知ることができる。

【０１５２】さらに、画像情報を得る手段としてディジタルカメラ手段を用いれば眼前にある物体や状態に基づき迅速に画像情報を生成でき、その物体や状態の属性情報を迅速に知ることができる。

【０１５３】物体としては、美術品の他に、衣服やネクタイ、動物、植物、魚類、食品等を適用することができ、本発明によれば、これらの画像情報に基づき、物体の属性情報を知ることができる。

【０１５４】特に、本発明においては、魚類や食品の鮮度を属性情報として含めることができるため、これらの鮮度を知ることが可能となる。

【０１５５】状態としては、靴跡や医療検査結果等を採用することができ、靴跡の元になった靴の製造会社名や検査結果に基づく診断結果を得ることができる。また、レントゲン写真を画像情報としているため、本発明によればレントゲン写真に基づき、診断結果を得ることが可能である。

【０１５６】また、データベースにデータベース管理手段を備えさせているため、通信回線を介してデータベースシステムにアクセスする場合でも通信回線のトラフィック量を小さく抑えることが可能である。

【０１５７】本発明のデータベースシステムは、このように、特徴量で画像情報を検索しうるデータベース管理手段を備えているため、利用者はこのデータベースシステムを用いて画像情報が表す物体や状態の属性情報を得ることができる。

【０１５８】さらに、本発明は、これらの特別なデータ構造を有するデータベースを格納したコンピュータ読み取り可能な記録媒体であるため、コンピュータから画像情報の特徴量を利用して画像情報を検索することができ、属性情報も得ることができる。

【０１５９】また、本発明は、記録媒体読み取り手段によって入力画像情報を所定の記録媒体から読み取る。したがって、画像を撮影する場所と画像識別装置が離れた場所にある場合でも画像の属性情報を知ることができる。

【０１６０】また、本発明によれば、インターネットや携帯電話通信回線等を利用して、入力画像情報や属性情報を送受信する手段を備えているため、遠隔地から画像識別装置を利用可能である。

【図面の簡単な説明】

【図１】本発明の好適な実施の形態にかかる画像識別装置の構成ブロック図である。

【図２】本発明の好適な実施の形態にかかるデータベースシステムの構成ブロック図である。

【図３】データベースのデータ構造を表す説明図である。

【図４】他の実施の形態にかかる画像識別装置の構成ブロック図である。

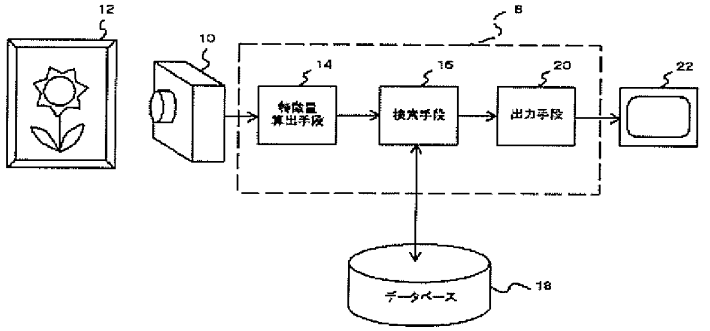
【符号の説明】

8　画像識別装置
１０　ディジタルカメラ
１２　絵画
１４　特徴量算出手段
１６　検索手段
１８　データベース
２０　出力手段
２２　表示手段
３０　データベースシステム
３２　データベース管理手段
３８　画像識別装置
４０　記録媒体読み取り手段
４２　電子メール通信手段
４４　移動体通信手段

【図１】

図1

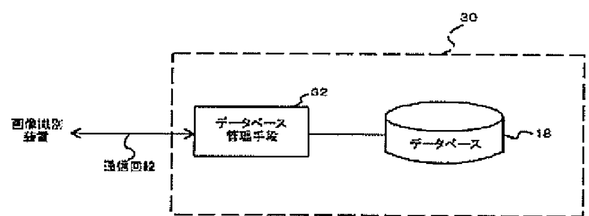
CDX−0005



【図２】

図2

CDX−0005



【図３】

図3

CDX−0005

物体1の画像情報	特徴量	物体1の属性情報
物体2の画像情報	特徴量	物体2の属性情報
物体3の画像情報	特徴量	物体3の属性情報

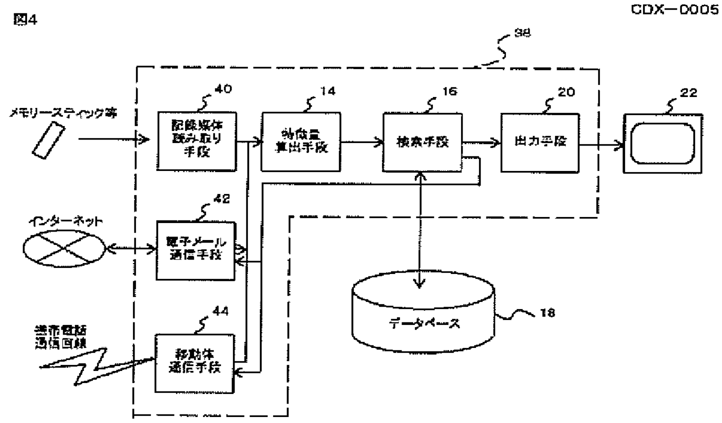
インデックステーブル

特徴量
特徴量

【図４】

図4

CDX—0005



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	１７０		１７０Ｂ　５Ｃ０６４
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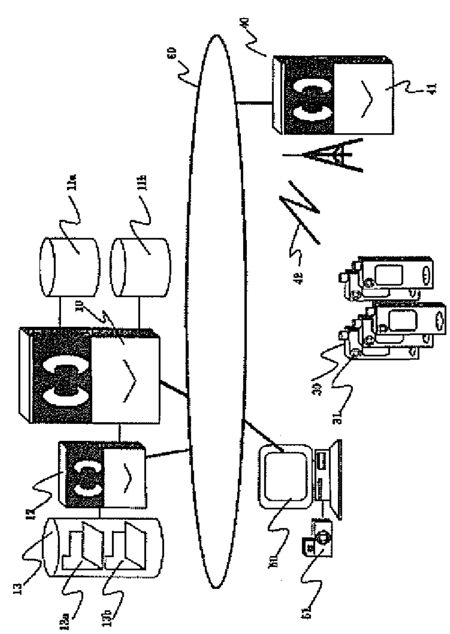
(54)【発明の名称】　情報検索方法、情報検索サーバーおよび携帯端末

(57)【要約】
【課題】　個人的または家庭的な利用に好適な、画像認識による情報検索方法を提供する。
【解決手段】　情報照会者がカメラ３１により撮影した画像データを携帯端末３０の送信機能によってメールサーバー１２に送信すると、この検索画像添付メールはメールサーバー１２の受信フォルダ１３ａに格納される。この画像データは、検索サーバー１０の機能によって電子メールより分離され、画像キーとなる。この画像キーは、検索サーバー１０の記録媒体１１ｂ内に格納された標準パターンと照合された後、標準パターンと関連付けられた記録媒体１１ａ内に格納されたデータベース登録情報が抽出され、当該抽出情報が携帯端末３０に返信される。



【特許請求の範囲】

【請求項１】　携帯端末から検索キーとしての画像データを検索サーバーに送信し、該検索サーバーは当該画像データから画像認識により標準パターンを識別し、該標準パターンに予め関連付けられているデータベース登録情報を前記携帯端末に応信することからなる情報検索方法。

【請求項２】　携帯端末から入手した画像データを入力パターンとし、内部に蓄積した標準パターンと比較する画像認識により、該標準パターンに予め関連付けられているデータベース登録情報を抽出し、該登録情報を前記携帯端末に応信する情報検索サーバー。

【請求項３】　前記データベース登録情報と前記標準パターンを格納する記録媒体を有する請求項２記載の情報検索サーバー。

【請求項４】　前記携帯端末から送信される画像データをメールサーバーを介して入手する請求項２または請求項３記載の情報検索サーバー。

【請求項５】　電子カメラを備えた携帯端末であって、該電子カメラにて撮影した画像データを情報検索サーバーに送信する手段と該情報検索サーバーからの電子メールを受信する手段とを有する携帯端末。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、携帯端末を使用した情報検索方法に関し、特に、検索サーバーにおいて画像認識による情報検索を行わせ、その検索結果をネットワーク上から携帯端末にて取得することのできる情報検索方法に関するものである。

【０００２】

【従来の技術】従来、電子データベースの検索には、文字、記号等が検索キーとして用いられているが、近年になり画像を検索キーとすることも行われるようになってきた。このような画像認識による画像データベースは、各種工業、物流や医療の分野において、大きな成果を上げている。また、個人認証や防犯、地図などの分野にも普及しつつある。しかしながら、これらの情報検索は大規模なシステムであったり、高額なシステムによって行われるものが殆どであり、個人的または家庭的に、手軽に利用可能なシステムとしては構成されていない。

【０００３】例えば、酒、ワインなどの趣向品を入手または識別する際、現物があれば、文字情報を検索キーとして使用したり、あるいは検索コードを使用する検索よりも、現物を撮影した画像情報から直接そのワインに関する情報を得ることができるので、極めて便利である。特に、ワインは世界中で生産され、ボトルに貼付されているエチケット（ラベル）は、各原産国語で記載されてあるばかりか、各国または各地区の法律や規則による記載方法が採用され、同じ名称で中身の違うものも多数存在するし、年代によって評価の異なることは周知の事実である。従って、ワインの鑑別には奥深い知識が必要となり、単に、エチケットに表示された文字を検索キーとしても、正確な情報を得ることは難しい。

【０００４】

【発明が解決しようとする課題】本発明は、普及の著しいインターネットと携帯電話に代表される携帯端末を利用することにより、必要とするデータベース情報を簡単かつ手軽に取得することを解決課題とするものであり、個人的または家庭的な利用に好適な、画像認識による情報検索方法を提供するものである。

【０００５】

【課題を解決するための手段】本発明の情報検索方法は、携帯端末から検索キーとしての画像データを検索サーバーに送信し、該検索サーバーは当該画像データから画像認識により標準パターンを識別し、該標準パターンに予め関連付けられているデータベース登録情報を前記携帯端末に応信することを特徴とするものである。本発明の情報検索サーバーは、携帯端末から入手した画像データを入力パターンとし、内部に蓄積した標準パターンと比較する画像認識により、該標準パターンに予め関連付けられているデータベース登録情報を抽出し、該登録情報を前記携帯端末に応信することを特徴とするものである。前記情報検索サーバーは、前記データベース登録情報と前記標準パターンを格納する記録媒体を有することが好ましい。また、前記携帯端末から送信される画像データをメールサーバーを介して入手することが好ましい。本発明の携帯端末は、電子カメラを備え、該電子カメラにて撮影した画像データを情報検索サーバーに送信する手段と該情報検索サーバーからの電子メールを受信する手段とを有することを特徴とするものである。

【０００６】

【発明の実施の形態】以下、本発明の好適な実施形態を、図面を参照しながら説明する。図１は、本発明による携帯端末を使用した情報検索システムの全体説明図である。同図上段には画像認識による情報検索を行う検索サーバー１０と、この検索サーバー１０と外部間の電子メール送受信機能を担うメールサーバー１２が図示されている。検索サーバー１０の右側には、本情報検索システムの特徴部として検索サーバー１０の管理制御対象である、データベース登録情報が格納された記録媒体１１ａと、画像認識における「標準パターン」が格納された記録媒体１１ｂとを取り出して示している。また、メールサーバー１２の左側に取り出して示されている記録媒体１３には、外部ネットワークから送信されて来る検索画像添付メールを受け入れるための受信フォルダ１３ａと、標準パターン添付メールを受け入れるための受信フォルダ１３ｂとが設けられている。なお、メールサーバー１２は検索サーバー１０と一体として設けてもよい。

【０００７】符号３０、３０、・・・は、カメラ３１を具備した携帯端末であり、電波４２を介して、携帯端末

３０、３０、・・・の信号をインターネット信号に変換する接続サーバー４１に接続されている。勿論、カメラ３１は携帯端末３０と一体でなくとも差し支えない。固定端末５０は、標準パターンをネットワーク上から検索サーバー１０の記録媒体１１ｂに登録する目的で使用されるパソコン等であり、画像入力機器であるカメラ５１を備えている。そして、上記検索サーバー１０、メールサーバー１２、接続サーバー４１、固定端末５０は、インターネット等のネットワーク網６０により接続されている。

【０００８】本発明では、携帯端末３０の利用者（以下、照会者という。）が接続サーバー４１経由で検索サーバー１０内に蓄積されたデータベース登録情報を入手することができるものである。図２は、入力パターンとしての画像キーの作成方法を示す説明図であり、同図には、調査の対象物２０とそれに貼られている識別用ラベル２１、カメラ３１付きの携帯端末３０、画像キー（入力パターン）として送信されるデータのイメージ図２３が描かれている。

【０００９】先ず、照会者はカメラ３１により対象物２０の点線２２の範囲を撮影し、対象物２０の正面図２０ａと識別用ラベル２１の正面図２１ａとから構成されるイメージデータ２３を得る。このイメージデータ２３は、携帯端末３０の送信機能によって添付ファイルとしてメールサーバー１２に送信され、検索画像添付メール用の受信フォルダ１３ａに格納される。この画像データは、後述する検索サーバー１０の機能によって電子メールより分離され、画像キーとなる。この画像キーは、記録媒体１１ｂ内に格納された標準パターンと照合された後、標準パターンと関連付けられた記録媒体１１ａ内に格納されたデータベース登録情報が抽出され、当該抽出情報が携帯端末３０に返信される。

【００１０】また、画像認識において標準パターンとなる画像データは、通常、検索サーバー１０内において作成・蓄積されるが、補助的には、外部からネットワーク６０を介して検索サーバー１０内に蓄積されてもよい。この場合、カメラ５１を備える固定端末５０によって作成された標準パターン添付メールは、ネットワーク６０を介してメールサーバー１２の受信フォルダ１３ｂに格納され、当該画像データは、後述する検索サーバー１０の機能によって電子メールから分離され、標準パターン格納用の記録媒体１１ｂ内に格納される。上記外部からの標準パターンの蓄積作業は、検索サーバー１０における蓄積作業だけでは標準パターンの収集に限界がある場合に、特に有益である。

【００１１】図３は、検索サーバー１０の構成を示すブロック図である。検索サーバー１０は、各種データに対する処理、入出力、送受信を行うために通常備えるべき構成部として、検索サーバー１０全体の動作を制御する制御部３２０と、データ処理を行う処理部３３０と、各

種入出力装置及びネットワーク６０等に接続される入出力インターフェース３１０と、該入出力インターフェース３１０からデータを受け取る入力部３５０と、データを出力する出力部３６０と、データ処理の際に一時的にデータを記憶する記憶部３４０と、各種データを受信する受信部３７０と、各種データを送信する送信部３８０とを備えている。

【００１２】検索サーバー１０は、前記通常備えるべき構成部に加えて更に、電子メールの送受信・転送機能を有するメーラー部３０００と、メールサーバー１２の受信フォルダ１３ａへの着信を常時監視する１３ａファイル監視部３００１と、画像添付メールを画像データとその他のデータとに分離する入力データ分離部３００２と、携帯端末の固有識別ＩＤやメールアドレスに関する登録データを蓄積したＩＤ蓄積部３００３と、該登録データを基にして検索サーバー１０自身の応答可否を判断するＩＤ判断部３００４と、検索キーとして入力された画像データに対して補正処理を行う入力パターン補正部３００５と、補正後の画像データから特徴パラメータあるいは特徴ベクトルを抽出する特徴抽出部３００６と、画像認識のための標準パターンを蓄積しておく標準パターン蓄積部３００７と、前記抽出された特徴量を標準パターンと対比した後、データベース情報蓄積部３０１２から、選定した標準パターンと関連付けられたデータベース情報を抽出する識別部３００８と、照会に対する応答情報を生成する応答情報生成部３００９と、前記応答情報の作成を通知する電子メールを生成するメール生成部３０１１と、メールサーバー１２の受信フォルダ１３ｂへの着信を常時監視する１３ｂファイル監視部３０１３と、リンク情報生成部３０１５とを備えている。

【００１３】続いて、検索サーバー１０の作用を説明する。携帯端末３０から発信された画像添付メールは、メールサーバー１２の受信フォルダ１３ａに受信され、当該受信は受信フォルダ１３ａへの着信を常時監視する１３ａファイル監視部３００１により検知されて、制御部３２０に報告される。報告を受けた制御部３２０は、処理部３３０に指示し、画像添付メールをメーラー部３０００を使用して、メールサーバー１２の受信フォルダ１３ａから入出力インターフェース３１０を経由して入力部３５０に入力させ、更に処理部３３０の指示により記憶部３４０に転送させる。

【００１４】転送された画像添付メールは、入力データ分離部３００２によってメールアドレス、携帯端末の持つ固有の識別ＩＤ、画像データとその他のデータとに分離される。次に、分離された各データの中、携帯端末の持つ固有の識別ＩＤを基に、検索サーバー１０が応答しても良いかどうか判断する。即ち、前記固有の識別ＩＤが、予めＩＤ蓄積部３００３に蓄積された登録データと一致するか否かがＩＤ判断部３００４により照合され、その結果が処理部３３０に報告される。

【００１５】処理部３３０に応答許可の報告がなされると、前記分離された画像データは処理部３３０の指示を受けた入力パターン補正部３００５による補正処理を受ける。これは、入力パターンを標準パターンと照合する前に、入力パターンとしての画像データに含まれる情報の中で、識別に不必要な情報をできる限り取り除く作業であり、画像認識における認識精度と処理速度を向上させるための工程である。入力パターン補正部３００５によって補正された画像データは処理部３３０の指示を受けた特徴抽出部３００６によって特徴パラメータあるいは特徴ベクトルを求められる。特徴パラメータおよび特徴ベクトルとは、識別を行うのに有効なパターンの性質として、入力パターンから取り出されたデータである。

【００１６】このようにして抽出された特徴量は、次に識別部３００８によって標準パターン蓄積部３００７（前出検索サーバー１０の記録媒体１１ｂに相当する。）の標準パターン（画像データ）を基に、どの標準パターンと合致するか、または、最も近いかが識別され、この標準パターンと関連付けられたデータベース情報蓄積部３０１２（前出検索サーバー１０の記録媒体１１ａに相当する。）のデータが処理部３３０に報告される。

【００１７】上記報告を受けた処理部３３０は、応答情報生成部３００９に指示し、応答用のデータを生成させる一方、応答データが作成されたことを照会者に知らせる電子メールを作成するため、メール生成部３０１１に指示し、予め用意されたメッセージと生成された応答用のデータファイルの場所を記したＵＲＬを合成した電子メールを作成し、送信部３８０に転送する。転送されたメールデータは、電子メールとして入出力インターフェース３１０を経由してメールサーバー１２へ送られ、メールサーバー１２は、当該電子メールを照会した携帯端末３０に送信する。

【００１８】携帯端末３０により上記メールを受信した照会者は、受信メール中で指定されたＵＲＬに応答用のデータを読みに行くことにより、例えば、図４の左半部に示す携帯端末３０の表示画面４０１に、図４の右半部に示すようなワイン情報４０２を入手することができる。なお、上記の説明では、メールサーバー１２は、応答データに関するＵＲＬを電子メールとして送信したが、データベース中の応答データを添付した電子メールを照会者宛に直接返信することも可能である。

【００１９】前記したように、標準パターンとなる画像データは、通常方法に従い、検索サーバー１０内において作成・蓄積されるが、補助的作業としての外部からの標準パターンの蓄積作業について説明する。検索サーバー１０に標準パターンを登録しようとする者（以下、登録者）は、固定端末５０の画面上から、指定のＵＲＬ画面に入り、指定されたパスワードチェックを経て、リンク情報生成部３０１５による指示画面に、送信したい標準パターン情報を入力した後、標準パターンのファイル名の発行を受ける。

【００２０】次に、登録者は、前記発行されたファイル名を付した画像データを予め指定されたメールアドレスに送信する。この画像添付電子メールは、メールサーバー１２の標準パターン添付メール用の受信フォルダ１３ｂに格納される。該画像添付電子メールの受信は、受信フォルダ１３ｂへの着信を常時監視する１３ｂファイル監視部３０１３により検知されて、制御部３２０に報告される。報告を受けた制御部３２０は、処理部３３０に指示し、画像添付メールをメーラー部３０００を使って、該電子メールをメールサーバー１２の受信フォルダ１３ｂから入出力インターフェース３１０を経由して入力部３５０に入力させ、さらに処理部３３０の指示により、これを記憶部３４０に転送させる。

【００２１】転送された画像添付メールは、入力データ分離部３００２によってメールアドレス、画像データとその他のデータに分離される。次に、分離された各データの中、メールアドレスについて、検索サーバー１０が受諾しても良いかどうか判断する。即ち、前記メールアドレスが、予めＩＤ蓄積部３００３に蓄積された登録データと一致するか否かがＩＤ判断部３００４により照合され、処理部３３０に報告される。処理部３３０に受諾の報告がなされた場合のみ、前記分離された画像データは処理部３３０の指示を受け、標準パターン蓄積部３００７に蓄積される。

【００２２】

【発明の効果】本発明によれば、携帯電話に代表される携帯端末を利用することにより、必要とするデータベース情報を簡単かつ手軽に取得することができる。従って、酒、ワインなどの趣向品以外にも、動植物、鉱物、電機器械部品、日用品のパーツ、土木構造物、建築物、星座、その他、凡そ形のある物についての様々な情報の検索に幅広く適用することができる。また、本発明によれば、どの様な時間帯であっても、また、どの様な場所であっても、手元の携帯端末から検索サーバーにアクセスすることにより、直ちに欲する情報を入手することができるという優れた効果を有する。

【図面の簡単な説明】

【図１】本発明に係る携帯端末を使用した情報検索システムの全体説明図である。

【図２】入力パターンとしての画像キーの作成方法を示す説明図である。

【図３】検索サーバー１０の構成を示すブロック図である。

【図４】携帯端末３０の表示画面に示されるワイン情報の一例を示す。

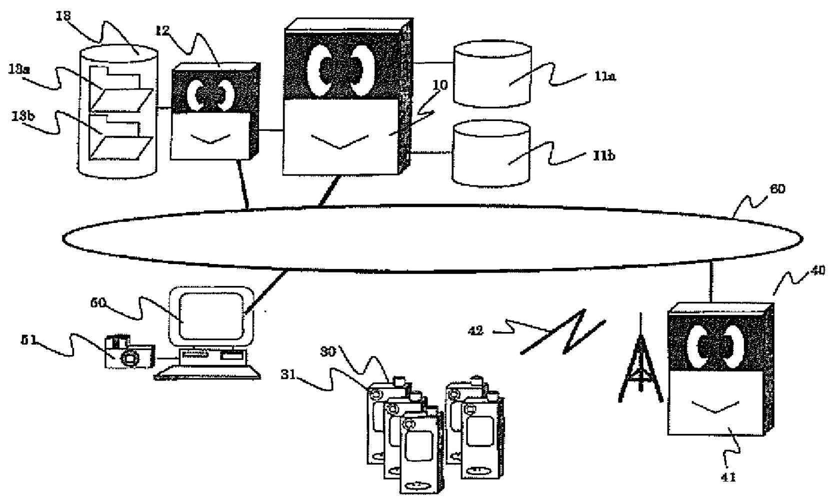
【符号の説明】

１０　情報検索サーバー

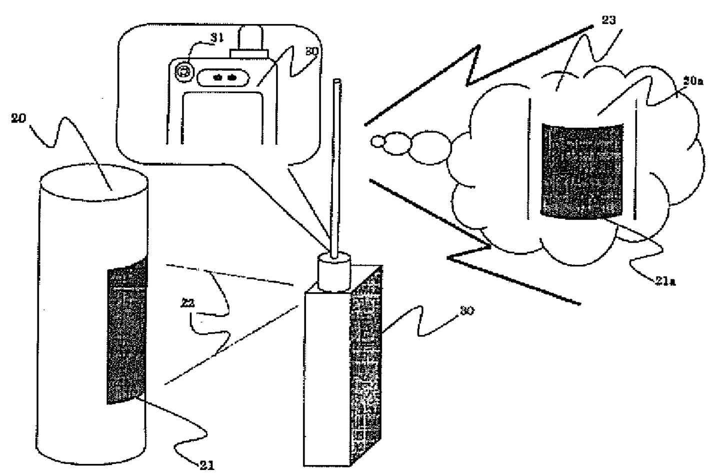
１１ａ　データベース登録情報が格納された記録媒体

１１ｂ　標準パターンが格納された記録媒体
１２　メールサーバー
１３　メールサーバーの記録媒体
＊３０　携帯端末
３１　電子カメラ
＊　６０　ネットワーク

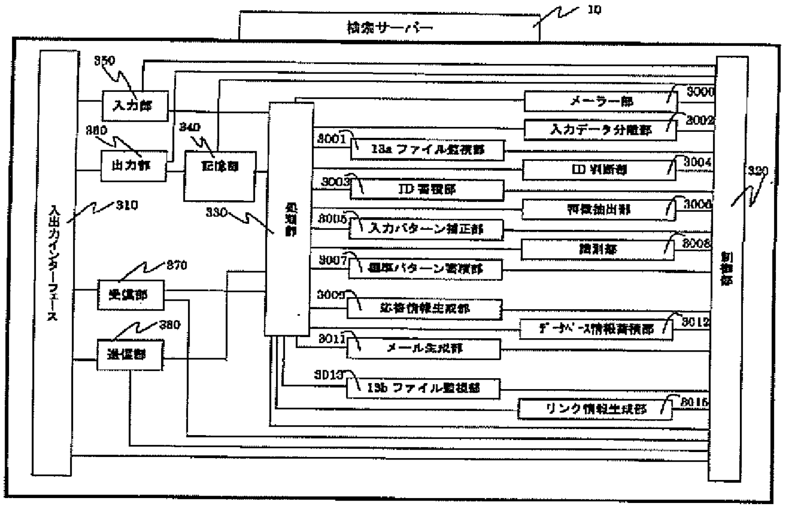
【図１】



【図２】



【図３】


検索サーバー
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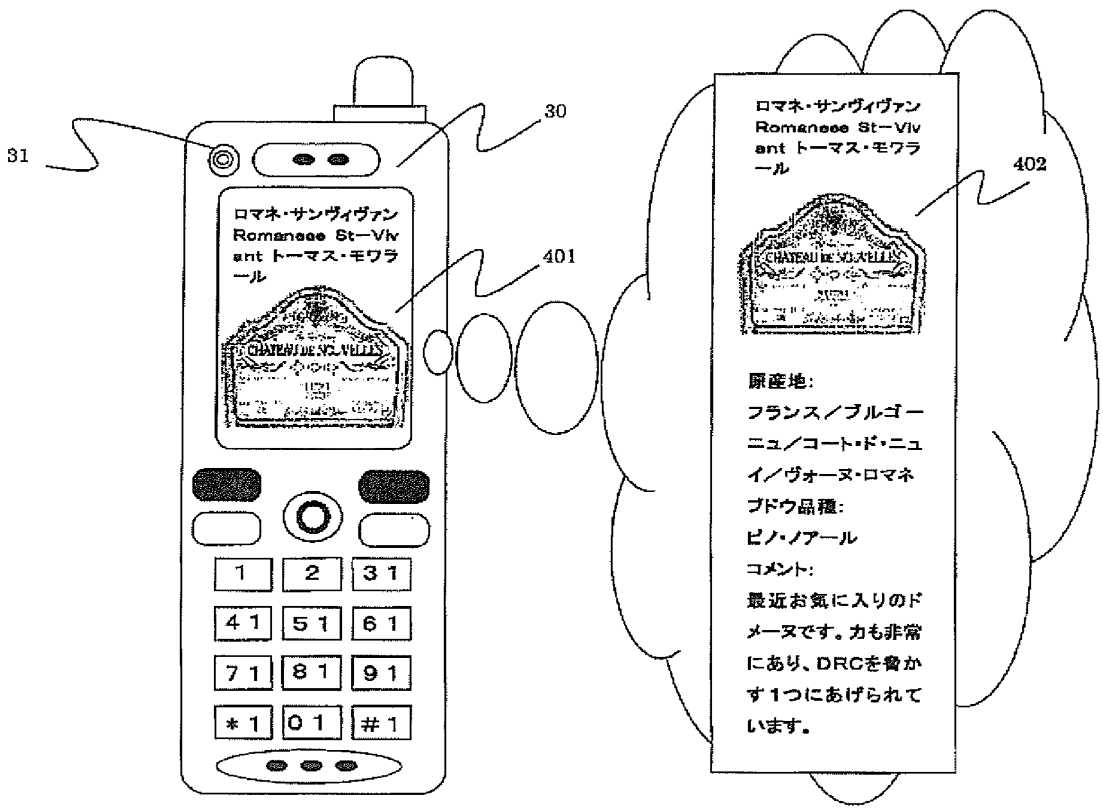
350
入力部
360
出力部
340
記憶部
330
処理部
310
入出力インターフェース
370
受信部
380
送信部
320
制御部
3000
メーラー部
3002
入力データ分離部
3001
13a ファイル監視部
3004
ID 判断部
3003
ID 蓄積部
3006
情報抽出部
3005
入力パターン補正部
3008
識別部
3007
標準パターン蓄積部
3009
応答情報生成部
3012
データベース情報蓄積部
3011
メール生成部
3013
13b ファイル監視部
3016
リンク情報生成部

【図４】


31
30
401
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ロマネ・サンヴィヴァン
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イ／ヴォーヌ・ロマネ
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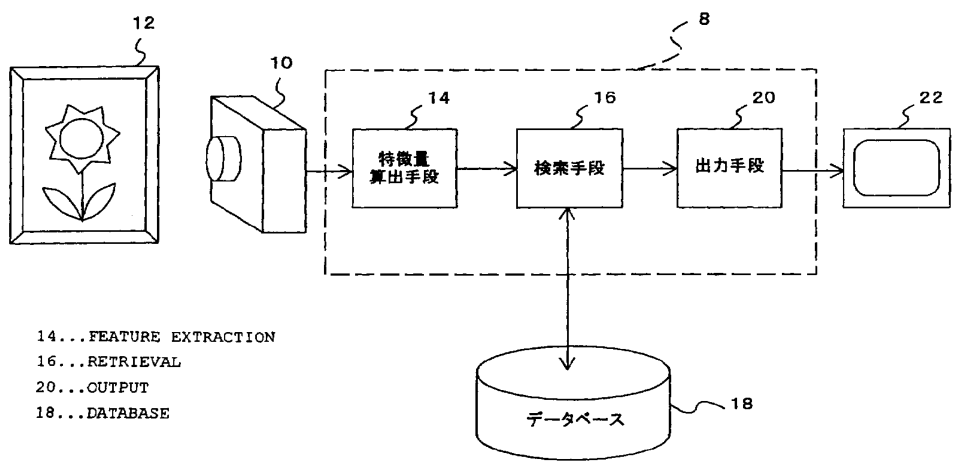
(54) Title: IMAGE RECOGNITION SYSTEM AND DATABASE SYSTEM FOR IMAGE RECOGNITION

(54) 発明の名称: 画像識別装置及び画像識別に用いられるデータベースシステム



(57) Abstract: Images of works of art are recognized to identify their attribute information such as the name of the artists who produced the works. A digital camera (10) takes pictures of a painting (12) and generates the digital images of the painting. Feature extraction means (14) extracts the features of the digital images of the painting. Retrieve means (16) compares the determined features with the features stored in a database (18) to find the image information corresponding to the features of the picture. The retrieval means (16) reads the attribute information about the image, such as the title and the painter, from the database (18), and sends it to output means (20), which in turn supplies it to display means (22) to present the title, the painter, and so on. Users can thus find the titles of paintings and the names of painters.

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(57) 要約:

美術品等の画像情報に基づき、その画像情報が表す物体の作者等の属性情報を知ることができる画像識別装置を提供することである。ディジタルカメラ１０が絵画１２を撮影し、その絵画のディジタル画像を生成する。特徴量算出手段１４は絵画のディジタル画像の特徴量を算出する。検索手段１６は、算出した特徴量と、データベース１８中に格納されている特徴量とを比較し、合致する特徴量に対応する画像情報を見つけだす。さらに、検索手段１６は、見つけだした画像情報の属性情報である作者名、絵画の名称等をデータベース１８から読み出し、出力手段２０に送出する。出力手段２０は、供給されてきた作者名、絵画の名称等を表示手段２２に表示させる。このようにして、利用者は絵画の名称や作者名を容易に知ることができる。

明　細　書

画像識別装置及び画像識別に用いられるデータベースシステム

技術分野

本発明は、画像識別装置に関する。特に、絵画等の画像を取得し、その絵画の作者等を知ることができる画像識別装置に関する。また、この画像識別装置が利用するデータ構造を有する記録媒体、及びこの画像識別装置が利用するデータベースシステムに関する。

背景技術

近年、絵画等の美術品をディジタル情報で保存しようとするいわゆるディジタルアーカイブ事業が広く行われている。このように美術品をディジタル情報で保存することにより、実物と異なり、半永久的な保存が可能となる。また、このような美術品のデータベースを作成することによって、例えば、作品名からその美術品を瞬時に表示することも可能となり、美術品に関する教育・研究に寄与すると考えられている。

発明の開示

このようなディジタルアーカイブ事業による美術品のデータベースによれば、作品名、作者名等から美術品を瞬時に検索することができるが、逆に、絵画等の画像情報からその作者名や作品名を知ること、すなわちデータベースの逆引きは困難であった。

また、植物図鑑等においても、植物の品種名からその植物の絵を検索する索引は存在しても、植物の画像（絵）からその植物の品種名を知ることは困難であった。

例えば、野外等に存在する植物の品種名を知りたい場合に、植物の画像から、その植物の品種名がわかるシステムが存在すれば、教育・研究に大きく資することは容易に予想できる。

美術品に関しても、その絵画等の画像に基づき、その作品名や作者名がわかれば教育・研究に大きく寄与することは想像に難くない。

しかしながら、従来、画像情報に基づき、その画像情報が表す物体（植物、美術品）の属性（品種名、作者名）を知ることができるシステム、ひいてはデータベースは知られていない。

本発明は、かかる課題に鑑みなされたものであり、その目的は、美術品等の画像情報に基づき、その画像情報が表す物体の作者等の属性情報を知ることができるシステムを提供することである。

第１の本発明は、上記課題を解決するために、与えられた入力画像情報の特徴量を算出する特徴量算出手段と、前記算出した特徴量と合致する特徴量を有する画像情報を、データベースから検索し、この検索によって見いだされた画像情報が表す物体の属性情報を、前記データベースから読み出す検索手段と、前記読み出した属性情報を出力する属性情報出力手段と、を含むことを特徴とする画像識別装置である。

このような構成によれば、特徴量を用いて検索しているため、画像情報が表す物体の属性情報を効率的に得ることができる。

第２の本発明は、画像情報と、前記画像情報が表す物体の属性情報と、前記画像情報の特徴量と、を格納するデータベースと、与えられた入力画像情報の特徴量を算出する特徴量算出手段と、前記算出した特徴量と合致する特徴量を有する画像情報を、前記データベースから検索し、この検索によって見いだされた画像情報が表す物体の属性情報を、前記データベースから読み出す検索手段と、前記読み出した属性情報を出力する属性情報出力手段と、を含むことを特徴とする画像識別装置である。

このような構成によればデータベースを含んでいるため、外部のデータベースにアクセスする必要がない。

第３の本発明は、物体の画像情報を生成するディジタルカメラ手段、を備え、前記ディジタルカメラ手段が、前記入力画像情報を生成することを特徴とする画像識別装置である。

物体の画像を生成するためにディジタルカメラ手段を備えているため、眼前に

ある物体に基づき、迅速に画像情報を生成することができ、その物体の属性情報を迅速に得ることができる。

第４の本発明は、前記物体は、美術品であり、前記属性情報には、少なくとも前記美術品の作者名及び作品名が含まれていることを特徴とする画像識別装置である。

このような構成によれば、美術品の作者名等を迅速に知ることができる。

第５の本発明は、前記物体は、絵画であり、前記属性情報には、少なくとも前記絵画の作者名及び作品名が含まれていることを特徴とする画像識別装置。

このような構成によれば、絵画の作品名等を迅速に知ることができる。

第６の本発明は、前記物体は、衣服であり、前記属性情報には、少なくとも前記衣服のブランド名が含まれていることを特徴とする画像識別装置である。

このような構成によれば、衣服のブランド名等を迅速に知ることができる。

第７の本発明は、前記物体は、ネクタイであり、前記画像情報は、前記ネクタイの柄を表す画像情報であることを特徴とする画像識別装置である。

このような構成によれば、ネクタイの柄に基づき、ネクタイのブランド名等を迅速に知ることができる。

第８の本発明は、前記物体は、植物であり、前記属性情報には、少なくとも前記植物の名称及び分類が含まれていることを特徴とする画像識別装置である。

このような構成によれば、植物の名称等を迅速に知ることができる。

第９の本発明は、前記物体は、動物であり、前記属性情報には、少なくとも前記動物の名称及び分類が含まれていることを特徴とする画像識別装置である。

このような構成によれば、動物の名称等を迅速に知ることができる。

第１０の本発明は、前記物体は、魚類であり、前記属性情報には、少なくとも前記魚類の名称及び分類が含まれていることを特徴とする画像識別装置である。

このような構成によれば、魚類の名称等を迅速に知ることができる。

第１１の本発明は、前記特徴量には、少なくとも前記魚類の目の色に重点を置いた鮮度特徴量が含まれており、前記データベースにはある種の前記魚類に関して、前記鮮度特徴量が異なる複数のエントリーが含まれていることを特徴とする画像識別装置。

このような構成によれば、魚類の鮮度を識別可能である。

第１２の本発明は、前記物体は、食品であり、前記属性情報には、少なくとも前記食品の名称が含まれていることを特徴とする画像識別装置である。

このような構成によれば、食品の鮮度を識別可能である。

第１３の本発明は、与えられた入力画像情報の特徴量を算出する特徴量算出手段と、前記算出した特徴量と合致する特徴量を有する画像情報を、データベースから検索し、この検索によって見いだされた画像情報が表す状態の属性情報を、前記データベースから読み出す検索手段と、前記読み出した属性情報を出力する属性情報出力手段と、を含むことを特徴とする画像識別装置である。

このような構成によれば、特徴量を用いて検索しているため、画像情報が表す状態の属性情報を効率的に得ることができる。

第１４の本発明は、画像情報と、前記画像情報が表す状態の属性情報と、前記画像情報の特徴量と、を格納するデータベースと、与えられた入力画像情報の特徴量を算出する特徴量算出手段と、前記算出した特徴量と合致する特徴量を有する画像情報を、前記データベースから検索し、前記検索によって見いだされた画像情報が表す状態の属性情報を、前記データベースから読み出す検索手段と、前記読み出した属性情報を出力する属性情報出力手段と、を含むことを特徴とする画像識別装置である。

このような構成によればデータベースを含んでいるため、外部のデータベースにアクセスする必要がない。

第１５の本発明は、所定の状態を表す画像情報を生成するディジタルカメラ手段、を備え、前記ディジタルカメラ手段が、前記入力画像情報を生成することを特徴とする画像識別装置である。

状態を表す画像を生成するためにディジタルカメラ手段を備えているため、眼前にある状態に基づき、迅速に画像情報を生成することができ、その状態の属性情報を迅速に得ることができる。

第１６の本発明は、前記状態は、靴の足跡を表す地表面、路面又は床面の状態であり、前記属性情報には少なくともその靴の製造会社名が含まれていることを特徴とする画像識別装置である。

このような構成によれば、靴の足跡に関し、その靴の製造会社名を迅速に知ることができる。

第１７の本発明は、前記状態は、医療検査結果であり、前記属性情報には少なくとも診断結果が含まれていることを特徴とする画像識別装置である。

このような構成によれば、医療の検査結果に基づき、診断結果を迅速に知ることができる。

第１８の本発明は、前記画像情報は、レントゲン写真を表す画像情報であることを特徴とする画像識別装置である。

このような構成によれば、レントゲン写真に基づき、診断結果を迅速に知ることができる。

第１９の本発明は、物体を表す画像情報と、前記画像情報が表す物体の属性情報と、前記画像情報の特徴量と、を格納する記憶手段と、前記特徴量をキーとして前記画像情報を検索する検索手段と、を含むことを特徴とするデータベースシステムである。

このようなデータベースシステムによれば、外部からの入力画像情報を含む問い合わせによって、その画像情報が表す物体の属性情報を知ることができる。

第２０の本発明は、状態を表す画像情報と、前記画像情報が表す状態の属性情報と、前記画像情報の特徴量と、を格納する記憶手段と、前記特徴量をキーとして前記画像情報を検索する検索手段と、を含むことを特徴とするデータベースシステムである。

このようなデータベースシステムによれば、外部からの入力画像情報を含む問い合わせによって、その画像情報が表す状態の属性情報を知ることができる。

第２１の本発明は、物体を表す画像情報と、前記画像情報が表す物体の属性情報と、前記画像情報の特徴量と、を格納したことを特徴とする記録媒体であって、前記特徴量をキーとして前記画像情報を検索しうることを特徴とするコンピュータ読み取り可能な記録媒体である。

このようなデータ構造を有する記憶媒体によれば、画像情報の特徴量に基づき、画像情報を検索し、さらに、その画像情報が表す物体の属性情報を得ることができる。

第２２の本発明は、状態を表す画像情報と、前記画像情報が表す状態の属性情報と、前記画像情報の特徴量と、を格納したことを特徴とする記録媒体であって、前記特徴量をキーとして前記画像情報を検索しうることを特徴とするコンピュータ読み取り可能な記録媒体である。

このようなデータ構造を有する記憶媒体によれば、画像情報の特徴量に基づき、画像情報を検索し、さらに、その画像情報が表す状態の属性情報を得ることができる。

第２３の本発明は、所定の記録媒体から前記入力画像情報を読み出す記録媒体読み出し手段、を備え、前記特徴量算出手段は、前記記録媒体から読み出した前記入力画像情報の特徴量を算出することを特徴とする画像識別装置である。

このような構成によれば、画像が格納された記録媒体に基づいて、画像識別が可能な画像識別装置が得られる。

第２４の本発明は、前記記録媒体は、ディジタルカメラ手段によって画像情報を書き込まれることが可能な記録媒体であることを特徴とする画像識別装置である。

このような構成によれば、まず、ディジタルカメラで画像を撮影し、記録媒体に格納し、次に、この画像が格納された記録媒体に基づいて、画像識別をすることが可能である。

第２５の本発明は、所定の通信回線から前記入力画像情報を受信する画像受信手段、を備え、前記特徴量算出手段は、前記画像受信手段が受信した前記入力画像情報の特徴量を算出することを特徴とする画像識別装置である。

このような構成によれば、通信回線を介して送信されてきた入力画像情報について、画像識別をすることが可能である。

第２６の本発明は、前記属性情報出力手段が出力した属性情報を、前記通信回線を介して送信する属性情報送信手段、を含むことを特徴とする画像識別装置である。

このような構成によれば、画像識別の結果である属性情報を通信回線を介して送信することができ、遠隔地から画像識別装置を利用可能である。

第２７の本発明は、前記画像受信手段は、前記通信回線から電子メールを受信

し、その電子メールに含まれる前記入力画像情報を抽出する電子メール受信手段、を含むことを特徴とする画像識別装置である。

このような構成によれば、電子メールに含まれる入力画像情報について、画像識別をすることが可能である。

第２８の本発明は、前記画像送信手段は、前記属性情報出力手段が出力した属性情報を含む電子メールを、前記通信回線を介して送信する電子メール送信手段、を含むことを特徴とする画像識別装置である。

このような構成によれば、画像識別の結果である属性情報を電子メールで送信することができ、遠隔地から画像識別装置を利用可能である。

第２９の本発明は、前記通信回線はインターネットであることを特徴とする画像識別装置である。

インターネットを通信回線として用いたので、インターネットにアクセス可能な場所から、画像識別装置を利用可能である。

第３０の本発明は、前記通信回線は移動体通信回線であり、前記画像受信手段は、前記移動体通信回線を介して、ディジタルカメラ手段から前記入力画像情報を受信する移動体端末受信手段、を含むことを特徴とする画像識別装置である。

このような構成によれば、移動体通信回線を介して受信した入力画像情報に基づき、画像識別を行うことができる。

第３１の本発明は、前記通信回線は、移動体通信端末によって通信を行う移動体通信回線であり、前記画像送信手段は、前記属性情報出力手段が出力した属性情報を、前記移動体通信回線を介して相手方の前記移動体通信端末に送信する移動体端末送信手段、を含むことを特徴とする画像識別装置である。

このような構成によれば、画像識別の結果である属性情報を移動体通信端末で受信することができ、遠隔地から画像識別装置が生成した属性情報を知ることができる。

第３２の本発明は、前記移動体通信回線は、携帯電話通信回線であることを特徴とする画像識別装置である。

携帯電話通信回線を用いて入力画像情報や属性情報を送受信するので、携帯電話を利用可能な場所から、画像識別装置を利用可能である。

図面の簡単な説明

図１は、本発明の好適な実施の形態にかかる画像識別装置の構成ブロック図である。

図２は、本発明の好適な実施の形態にかかるデータベースシステムの構成ブロック図である。

図３は、データベースのデータ構造を表す説明図である。

図４は、他の実施の形態にかかる画像識別装置の構成ブロック図である。

発明を実施するための最良の形態

以下、本発明の好適な実施の形態を図面に基づいて説明する。

実施の形態１

図１には、本発明の好適な実施の形態１にかかる画像識別装置８の構成ブロック図が示されている。

この図に示されているように、画像識別装置８は特徴量算出手段１４と、検索手段１６と、出力手段２０とから構成されている。

まず、ディジタルカメラ１０が絵画１２を撮影し、その絵画のディジタル画像を生成する。生成したディジタル画像は特徴量算出手段１４に送出される。特徴量算出手段１４は絵画のディジタル画像の特徴量を算出する。

次に、検索手段１６は、算出した特徴量と、データベース１８中に格納されている特徴量とを比較し、合致する特徴量に対応する画像情報を見つけだす。この画像情報は絵画の画像情報である。

さらに、検索手段１６は、見つけだした画像情報の属性情報である作者名、絵画の名称等をデータベース１８から読み出し、出力手段２０に送出する。出力手段２０は、供給されてきた作者名、絵画の名称等を表示手段２２に表示させる。

このようにして、本実施の形態１によれば、絵画をディジタルカメラ１０で撮影することによって、その絵画の作者や絵画の名称等が表示手段２２に示される。したがって、利用者は絵画の名称や作者名を容易に知ることができる。

さて、本実施の形態１において特徴的なことは、画像情報をデータベース１８

から検索する際に特徴量を用いていることである。画像の特徴量としては、従来から知られている種々の特徴量を用いることができる。

このような種々の特徴量を特徴量算出手段１４が算出するのである。特徴量そのものは、従来から知られているものであるため、その算出方法の説明は省略する。

また、データベース１８は、絵画に関するデータベースである。このデータベース１８には、絵画の画像情報と、その絵画の属性情報と、その画像情報の特徴量とが格納されている。属性情報とは、その絵画の作者名や絵画の名称等である。また、データベース１８は、特徴量をキーとして絵画の画像情報を検索しやすくするために、特徴量に関するインデックステーブルが設けられている。これによって、特徴量をキーとして画像の情報を迅速に検索することが可能なデータ構造がデータベース１８中に実現されている。

本実施の形態１においては、検索手段１６は、特徴量をキーとして検索した画像情報に関し、その属性情報をデータベース１８から読み出す。そして、検索手段１６は、読み出した属性情報、すなわち作者名等を表示手段２２に供給する。表示手段２２は、この作者名等の表示を行う。

データベース１８は種々の形態をとることができる。例えばコンピュータのハードディスク上に構成されていてもよい。また、例えばこの種の絵画のデータベースは美術館等に設置される場合も多いと考えられる。そのような場合には、画像識別装置８は、データベース１８から遠距離に存在することも多い。この場合は、画像識別装置８を通信回線を介してデータベース１８と接続する形態を採用することが好ましい。このように通信回線を介して画像識別装置８と接続するのに適したデータベースシステムの構成は後の実施の形態３においてさらに詳述する。

なお、属性情報としては、作者名や絵画の名称の他に、その絵画の制作年、所有者、サイズ、専門家による評論・説明等を利用することも好ましい。専門家による評論・説明等を属性情報として表示手段２２に表示すれば、利用者はその絵画の説明を見ることができ、学習・教育等の目的に資することができる。

また、上の説明では、絵画のディジタル画像はディジタルカメラ１０で生成し

たが、絵画の写真をスキャナーでスキャンすることによって絵画のディジタル画像を得ることも好ましい。また、ビデオ信号から絵画の静止画を取り込むように構成してもかまわない。いずれにしても、絵画のディジタル画像が得られればどのような手法を採用してもかまわない。

また、上の説明では、データベース１８を画像識別装置８と別体に構成したが、画像識別装置８の内部に含めてもかまわない。識別の対象となる絵画の種類が少なく、データベース１８が小規模である場合には、画像識別装置内部のハードディスク等に、このデータベース１８を構成する形態が好ましい。

また、表示装置２２は種々の表示装置を利用可能である。従来から用いられてきたＣＲＴや液晶表示装置など種々の表示装置が利用できる。さらに、上記説明では、表示装置２２を画像識別装置８と別体に構成したが、画像識別装置８の内部に含めてもかまわない。この場合、小型の液晶表示装置を画像識別装置８に備えさせれば、携帯に便利な小型化された画像識別装置も実現できる可能性がある。

なお、特徴量算出手段１４は、計算専用のハードウェアを用いることも好ましいが、ソフトウェアで実現することも好ましい。また、検索手段１６は、データベース１８にアクセスするためのソフトウェアで構成することが望ましい。さらに、出力手段は、外部の表示手段２２の種類にも依存するが、例えばビデオカードとそのビデオカードを駆動するソフトウェアで構成することが望ましい。

実施の形態２（応用分野）

上記説明では、絵画の例について説明したが、絵画に限らず、ディジタルカメラ等で撮影できる物体ならば、他の美術品や、動植物、衣服等でもかまわない。

２．１

美術品としては、絵画の他に彫刻等が考えられる。この場合は、データベース１８は、彫刻の画像情報、彫刻の画像情報の特徴量、彫刻の属性情報（彫刻の作者、彫刻の名称）を含むデータベースである。

２．２

物体が植物の場合は、植物の画像に基づき、その植物の名称や種類を知ることができる植物図鑑として利用することが可能である。この場合は、データベース１８は、植物の画像情報、植物の画像情報の特徴量、植物の属性情報を含むデー

タベースである。植物の属性情報には、その植物の名称や、学名、科、生態、繁殖地域、１年草か２年草か、等が含まれる。

２．３

物体が動物の場合も、植物とほぼ同様であり、動物の画像情報に基づき、その動物の名称や生態等を知ることができる。

また、その動物が食用の魚類である場合には、特に特徴量として魚の目の色に重点を置いたものを採用することが好ましい。これは、魚の鮮度を表す指標として魚の目の色が広く利用されていることに基づくものである。このような場合、データベース１８は、１種類の魚に対して、鮮度が異なる複数のエントリーを有するものとなる。例えば、ある魚の鮮度が高い画像情報に関しては、鮮度が高いある魚の画像情報、鮮度が高いある魚の画像情報の特徴量、鮮度が高いという情報を含むある魚の属性情報、を含むエントリーがデータベース１８中に格納されている。

そして、ある魚の鮮度が低い画像情報に関しては、鮮度が低いある魚の画像情報、鮮度が低いある魚の画像情報の特徴量、鮮度が低いという情報を含むある魚の属性情報、を含むエントリーがデータベース１８中に格納されている。

このように、単一の種類の物体に対して、鮮度の異なる複数のエントリーがデータベース１８中に含まれている。このようにデータベース１８を構築することによって、単にその魚の画像情報に基づいて、魚の名称を知ることができるだけでなく、その魚の鮮度も知ることができるという効果がある。

２．４

上記２．３においては、魚の鮮度を知ることができる画像識別装置について説明したが、同様の原理を用いて、一般の食品の鮮度を知ることができる画像識別装置を構成することも好ましい。

この場合、データベース１８は、魚の場合と同様に、１種類の食品に対して、鮮度が異なる複数のエントリーを有するものとなる。例えば、ある食品の鮮度が高い画像情報に関しては、鮮度が高いある食品の画像情報、鮮度が高いある食品の画像情報の特徴量、鮮度が高いという情報を含むある食品の属性情報、を含むエントリーがデータベース１８中に格納されている。

同様に、データベース１８中には、ある食品の鮮度が低い画像情報に関するエントリーも格納されている。

このようなデータベース１８を用いることによって、食品の鮮度も知ることができる画像識別装置が構成可能である。

２．５

物体が衣服の場合も、美術品等と同様であり、衣服の画像情報に基づき、その衣服のブランド名称や織り方の種類等を知ることができる。この場合は、データベース１８は、衣服の画像情報、衣服の画像情報の特徴量、衣服の属性情報を含むデータベースである。衣服の属性情報には、その衣服のブランド名や、繊維の種類、織り方、洗濯方法、価格等が含まれる。

特に、衣服がネクタイやスカーフの場合には、その形状よりも、むしろ図柄から識別できる場合が多い。そのため、ネクタイ等の場合には画像情報としてネクタイの一部を採用することが好ましい。そして、その図柄の画像情報に基づき、画像の特徴量や、その図柄を有するネクタイ等の属性情報、がデータベース１８に格納されているのである。

２．６

以上説明してきた例では、ある独立した１個の物体を表す画像情報を利用し、その物体の属性情報を得ている。しかし、画像情報を生成することができれば、物体そのものではなく、物体の「跡」や物体の様子等の「状態」でもよく、そのような状態を表す画像情報を用いて、その状態に関する属性情報を得ることも好ましい。

例えば、足跡等の物体の跡もディジタルカメラ１０等を用いることによって、足跡の画像情報を生成することができる。そして、その足跡に基づき、足跡を作った靴の属性情報を表示しうる画像識別装置８を構成することも好ましい。なお、ここで、足跡とは、地表の靴の跡や、路上や床の上の靴の跡である。

なお、靴の属性情報としては、その靴の製造会社名や、靴の材質等を利用することが好ましい。

また、「物体の様子」としては、例えばレントゲン写真画像等の検査結果が挙げられる。レントゲン写真の画像情報に関し、その特徴点に基づき合致する画像

をデータベース１８から検索することによって、そのレントゲン写真の属性情報を表示することができる。

属性情報としては、そのレントゲン写真に対する診断結果が好ましい。属性情報として診断結果が表示されることによって、いわば自動診断装置を構成することが可能である。

ここでは、レントゲン写真について説明したが、内視鏡写真等、画像で表現できるものであればどのような検査の結果でもかまわない。

実施の形態３（データベースシステム）

以上述べた説明においては、画像識別装置８は、特定のデータ構造を有するデータベース１８を利用していた。このデータベース１８は、既に述べたように、各エントリー中に、物体の画像情報と、その物体の画像情報の特徴量と、その物体の属性情報と、を含むことを特徴とするものである。また、既に述べたように、データベース１８は、各エントリー中に、状態の画像情報と、その状態の画像情報の特徴量と、その状態の属性情報と、を含むことをも特徴とするものである。

さて、一般に美術品等のデータベースは、美術館等に置かれて管理される場合が多い。したがって、上述したように画像識別装置８とデータベース１８とは通信回線で接続される場合も多いと考えられる。

この場合には、データベース８を単なる記憶手段としてではなく、検索機能も備えたデータベースシステム３０として構築するのが好ましい。これは、通信回線上のトラフィック量の軽減のためである。このようなデータベースシステム３０の構成ブロック図が図２に示されている。

データベース１８の代わりに、データベースシステム３０を用いる場合は、図１の検索手段１６は、データベースシステム３０に対し問い合わせ（クエリー）を発し、データベース管理手段３２がこの問い合わせ（クエリー）に応答してデータベース１８を検索して結果を検索手段１６に返送する。このような構成によれば、検索結果だけが通信回線状を流れるのでトラフィック量の軽減を図ることができる。なお、データベース管理手段３２は、コンピュータのソフトウェアで実現することが好ましい。

また、データベースシステム３０が美術館等に設置された場合は、上述した画

像識別装置８を用いずに、利用者が手作業でその絵画等の名称を知ることも可能である。

すなわち、利用者はまず、ディジタルカメラ１０等を用いて美術品の撮影をして画像情報を得る。次に、利用者は画像情報の特徴量を算出し、この特徴量と合致する画像情報をデータベース１８中から見つけるようにデータベースシステム３０に通信回線を介して依頼する。この依頼に基づき、データベースシステム３０のデータベース管理手段３２は対応する画像情報を検索し、その画像情報の属性情報である名称や作品名を利用者に送信するのである。利用者は通信回線を介して美術品の作品名や作者名を受信することによって、その美術品の属性を知ることができる。

以上のような構成のデータベースシステム３０は、美術品のデータベースだけでなく、上述した医療診断にも用いることができる。この場合にはそのデータベースシステム３０は例えば病院等に設置されることになろう。その結果、遠隔地にいる被検者に対していわゆる遠隔診断が可能となる。

実施の形態４（記録媒体）

以上述べた実施の形態においては、特別なデータ構造を有するデータベース１８を利用することを前提としていた。図３には、このデータベース１８のデータ構造が示されている。既に述べたように、このデータベース１８は、ある物体の画像情報と、その画像情報の特徴量と、その物体の属性情報と、を含んでいる。なお、図３には示していないが、データベース１８は、ある状態の画像情報と、その画像情報の特徴量と、その状態の属性情報と、を含む構成でもよいことは上述の通りである。

このような特別なデータ構造を記録媒体に格納することによって、データベースが構築されている。したがって、特徴量を用いて画像情報の検索をすることができるのである。なお、検索をより高速にするために、特徴量に関するインデックステーブルを構築することも好ましい（図３参照）。

なお、記録媒体としては、コンピュータ読み取り可能な記録媒体であればどのようなものでもかまわない。例えば、フロッピーディスクでもかまわないし、ハードディスクやＣＤＲＯＭ等を利用することも好ましい。

このようにコンピュータ読み取り可能な記録媒体中にデータベース１８を構成させれば、コンピュータを用いて画像識別装置を容易に構成できる。また、そのコンピュータの利用者が記録媒体中のデータベース１８にアクセスすることによって、画像情報に基づき、その画像情報が表す物体や状態の属性情報を得ることも可能である。

実施の形態５（入力画像情報の取得形態）

以上述べた実施の形態においては、入力画像情報は図１に示されているように外部のディジタルカメラ１０等から直接供給されていた。

しかし、ディジタルカメラ１０と画像識別装置８とを直接接続しなくても、通信回線を介して画像情報を供給することも好ましい。また、画像情報を一旦記録媒体に格納し、この記録媒体を画像識別装置に供給する形態を採用することも好ましい。

以下、本実施の形態５においては、入力画像情報を画像識別装置に供給する種々の形態について説明する。

図４には本実施の形態５にかかる画像識別装置３８は、図１と同様に、特徴量算出手段１４と、検索手段１６、出力手段２０を備えている。また、表示手段２２が出力手段２０に接続され、データベース１８が検索手段に接続されている。これらの構成は上記実施の形態１と同様の動作を行っている。

５．１

本実施の形態５において特徴的なことは、記録媒体読み取り手段４０が特徴量算出手段１４に接続されていることである。この記録媒体読み取り手段４０は、コンパクトフラッシュやスマートメディア等の記録媒体から入力画像情報を読み取り、特徴量算出手段１４に供給する。特徴量算出手段１４は、供給された入力画像情報に基づき特徴量を算出するのである。

このような構成によれば、ディジタルカメラ１０を直接画像識別装置３８に接続しなくても、入力画像情報を画像識別装置３８に供給することができる。

すなわち、利用者はまず、ディジタルカメラ１０等を用いて画像を撮影し、入力画像情報を得る。この入力画像情報は上述したコンパクトフラッシュ等の記録媒体に格納される。一般にディジタルカメラ１０等はこのようなコンパクトフラ

ッシュやスマートメディア等の記録媒体に画像を格納する機能を有している。

利用者は、このようにして画像を格納した記録媒体を、画像識別装置３８の記録媒体読み取り手段４０に読み取らせる。記録媒体読み取り手段４０は、読み取った画像を入力画像情報として特徴量算出手段１４に供給する。以下の動作は上記実施の形態１と同様であり、利用者は、画像の識別の結果である属性情報等を表示手段２２の画面上で見ることができる。

このような動作によって、利用者は画像識別装置３８と離れた場所で画像を撮影することができる。

なお、記録媒体としては可搬性を有するものであれば種々のものを採用することができる。上述したコンパクトフラッシュの他、メモリースティックや、フロッピーディスク、ＣＤ－Ｒ等でも好ましい。また、リムーバブルハードディスクのような記録媒体でもかまわない。

ただし、本実施の形態５では、画像の格納のために記録媒体を用いているため、ディジタルカメラ１０等の画像取得手段が画像情報を書き込み可能な記録媒体であることが最も望ましい。

また、記録媒体読み取り手段４０は、コンパクトフラッシュやスマートメディア、メモリースティック等を読み書きするドライブ装置、及びこのドライブ装置を駆動するドライバフログラムで構成する事が好ましい。

５．２

さらに、本実施の形態５において特徴的なことは、電子メール通信手段４２が特徴量算出手段１４に接続されていることである。この電子メール通信手段４２は、インターネット等の通信回線を介して電子メールを受信する。そして、この電子メールに含まれている入力画像情報を抽出し、特徴量算出手段１４に供給する。特徴量算出手段１４は、供給された入力画像情報に基づき特徴量を算出するのである。

このような構成によれば、ディジタルカメラ１０を直接画像識別装置３８に接続しなくても、入力画像情報を画像識別装置３８に供給することができる。

すなわち、利用者はまず、ディジタルカメラ１０等を用いて画像を撮影し、撮影した入力画像情報を、その撮影した場所でノートパソコン等に格納する。次に、

利用者はノートパソコン等の通信機能を利用し、得た入力画像情報を添付した電子メールを画像識別装置宛に送信する。

電子メール通信手段４２は、インターネット等の通信回線を介して送信されてきた電子メールを受信する。そして、この電子メールに添付されている上記入力画像情報を抽出し、特徴量算出手段１４に供給する。以下の動作は上記実施の形態１と同様であり、画像識別装置３８は、画像の識別の結果である属性情報等を得る。

さらに、本実施の形態５にかかる電子メール通信手段４２は、得た属性情報等を電子メールを使用して返信する機能を備えている。すなわち、電子メール通信手段４２は、検索手段１６が得た属性情報等を含む電子メールを、入力画像情報を送った相手先に返信するのである。利用者は、返信されてきた電子メールを見ることによって、属性情報等を知ることができる。

この結果、利用者は、画像識別装置３８から遠く離れた場所からでも画像識別装置３８の機能を利用することができ、利便性の高い画像識別装置３８が実現可能である。

なお、本発明の画像受信手段や属性情報送信手段は、本実施の形態５の電子メール通信手段４２に相当する。さらに、本発明の電子メール送信手段や電子メール受信手段も、本実施の形態５の電子メール通信手段４２に相当することは言うまでもない。

また、電子メール通信手段４２は、具体的にはモデム又はターミナルアダプタ等と、電子メールソフトウェアと、から構成することが好ましい。

５．３

上述した例ではインターネットを利用した電子メールによって、入力画像情報と属性情報を送受信する例を示した。しかし、入力画像情報と属性情報を送受信できれば、必ずしも電子メールを用いなくてもかまわない。

特に、近年のディジタルカメラ１０は高機能化され、携帯電話等を利用して遠隔地のパソコンと通信する機能を備えている場合も多い。このようなディジタルカメラ１０を用いる場合には、インターネットを介さずに移動体通信回線等の一般の公衆回線を介して入力画像情報と属性情報を送受信することも好ましい。

このようなことを実現するために、本実施の形態５では、移動体通信手段４４が特徴量算出手段１４に接続されている。この移動体通信手段４４は、携帯電話などの移動体通信回線を利用して入力画像情報や属性情報を送受信する手段である。そして、移動体通信手段４４は移動体通信回線を介して受信した入力画像情報を抽出し、特徴量算出手段１４に供給する。特徴量算出手段１４は、供給された入力画像情報に基づき特徴量を算出するのである。

このような構成によれば、ディジタルカメラ１０を直接画像識別装置３８に接続しなくても、入力画像情報を画像識別装置３８に供給することができる。

すなわち、利用者はまず、ディジタルカメラ１０等を用いて画像を撮影し、撮影した入力画像情報を、携帯電話による通信を利用して、得た入力画像情報を画像識別装置３８に送信する。

画像識別装置３８の移動体通信手段４４は、移動体通信回線を介して送信されてきた入力画像情報を受信する。そして、この入力画像情報を、特徴量算出手段１４に供給する。以下の動作は上記実施の形態１と同様であり、画像識別装置３８は、画像の識別の結果である属性情報等を得る。

さらに、本実施の形態５にかかる移動体通信手段４４は、得られた属性情報等を移動体通信回線を介して携帯電話に返信する機能を備えている。すなわち、移動体通信手段４４は、検索手段１６が得た属性情報等を、入力画像情報を送った相手先に返信するのである。利用者は、返信されてきた属性情報等を携帯電話上で見ることによって、属性情報等を知ることができる。なお、近年の携帯電話は高機能化され、単なる電話機能だけでなく、各種の情報を表示する機能を有している。

この結果、利用者は、画像識別装置３８から遠く離れた場所からでも画像識別装置３８の機能を利用することができ、利便性の高い画像識別装置３８が実現可能である。

なお、本発明の画像受信手段や属性情報送信手段は、本実施の形態５の移動体通信手段４４に相当する。さらに、本発明の移動体端末受信手段や移動体端末送信手段も、本実施の形態５の移動体端末通信手段４４に相当することは言うまでもない。

また、移動体通信手段４４は、携帯電話と、携帯電話を利用してデータ通信を行うためのアダプタ等と、から構成することが好ましい。

以上述べたように、本発明によれば、画像の特徴量を利用して画像情報を検索し、その画像情報が表す物体や状態の属性情報を知ることができる。その結果、絵画などの美術品の画像情報に基づき、その絵画等の美術品の作品名や作者名を知ることができる画像識別装置が実現できる。

また、画像識別装置にデータベースを備えさせれば、外部のデータベースにアクセスせずに画像情報に基づき属性情報を知ることができる。

さらに、画像情報を得る手段としてディジタルカメラ手段を用いれば眼前にある物体や状態に基づき迅速に画像情報を生成でき、その物体や状態の属性情報を迅速に知ることができる。

物体としては、美術品の他に、衣服やネクタイ、動物、植物、魚類、食品等を適用することができ、本発明によれば、これらの画像情報に基づき、物体の属性情報を知ることができる。

特に、本発明においては、魚類や食品の鮮度を属性情報として含めることができるため、これらの鮮度を知ることが可能となる。

状態としては、靴跡や医療検査結果等を採用することができ、靴跡の元になった靴の製造会社名や検査結果に基づく診断結果を得ることができる。また、レントゲン写真を画像情報としているため、本発明によればレントゲン写真に基づき、診断結果を得ることが可能である。

また、データベースにデータベース管理手段を備えさせているため、通信回線を介してデータベースシステムにアクセスする場合でも通信回線のトラフィック量を小さく抑えることが可能である。

本発明のデータベースシステムは、このように、特徴量で画像情報を検索しうるデータベース管理手段を備えているため、利用者はこのデータベースシステムを用いて画像情報が表す物体や状態の属性情報を得ることができる。

さらに、本発明は、これらの特別なデータ構造を有するデータベースを格納したコンピュータ読み取り可能な記録媒体であるため、コンピュータから画像情報の特徴量を利用して画像情報を検索することができ、属性情報も得ることができ

る。

　また、本発明は、記録媒体読み取り手段によって入力画像情報を所定の記録媒体から読み取る。したがって、画像を撮影する場所と画像識別装置が離れた場所にある場合でも画像の属性情報を知ることができる。

　また、本発明によれば、インターネットや携帯電話通信回線等を利用して、入力画像情報や属性情報を送受信する手段を備えているため、遠隔地から画像識別装置を利用可能である。

請求の範囲

１．与えられた入力画像情報の特徴量を算出する特徴量算出手段と、

前記算出した特徴量と合致する特徴量を有する画像情報を、データベースから検索し、この検索によって見いだされた画像情報が表す物体の属性情報を、前記データベースから読み出す検索手段と、

前記読み出した属性情報を出力する属性情報出力手段と、

を含むことを特徴とする画像識別装置。

２．画像情報と、前記画像情報が表す物体の属性情報と、前記画像情報の特徴量と、を格納するデータベースと、

与えられた入力画像情報の特徴量を算出する特徴量算出手段と、

前記算出した特徴量と合致する特徴量を有する画像情報を、前記データベースから検索し、この検索によって見いだされた画像情報が表す物体の属性情報を、前記データベースから読み出す検索手段と、

前記読み出した属性情報を出力する属性情報出力手段と、

を含むことを特徴とする画像識別装置。

３．請求の範囲１又は２記載の画像識別装置において、

物体の画像情報を生成するディジタルカメラ手段、

を備え、前記ディジタルカメラ手段が、前記入力画像情報を生成することを特徴とする画像識別装置。

４．請求の範囲１又は２記載の画像識別装置において、

前記物体は、美術品であり、前記属性情報には、少なくとも前記美術品の作者名及び作品名が含まれていることを特徴とする画像識別装置。

５．請求の範囲４記載の画像識別装置において、

前記物体は、絵画であり、前記属性情報には、少なくとも前記絵画の作者名及び作品名が含まれていることを特徴とする画像識別装置。

６．請求の範囲１又は２記載の画像識別装置において、

前記物体は、衣服であり、前記属性情報には、少なくとも前記衣服のブランド名が含まれていることを特徴とする画像識別装置。

７．請求の範囲６記載の画像識別装置において、

前記物体は、ネクタイであり、前記画像情報は、前記ネクタイの柄を表す画像情報であることを特徴とする画像識別装置。

８．請求の範囲１又は２記載の画像識別装置において、

前記物体は、植物であり、前記属性情報には、少なくとも前記植物の名称及び分類が含まれていることを特徴とする画像識別装置。

９．請求の範囲１又は２記載の画像識別装置において、

前記物体は、動物であり、前記属性情報には、少なくとも前記動物の名称及び分類が含まれていることを特徴とする画像識別装置。

１０．請求の範囲９記載の画像識別装置において、

前記物体は、魚類であり、前記属性情報には、少なくとも前記魚類の名称及び分類が含まれていることを特徴とする画像識別装置。

１１．請求の範囲１０記載の画像識別装置において、

前記特徴量には、少なくとも前記魚類の目の色に重点を置いた鮮度特徴量が含まれており、

前記データベースにはある種の前記魚類に関して、前記鮮度特徴量が異なる複数のエントリーが含まれていることを特徴とする画像識別装置。

１２．請求の範囲１又は２記載の画像識別装置において、

前記物体は、食品であり、前記属性情報には、少なくとも前記食品の名称が含まれていることを特徴とする画像識別装置。

１３．与えられた入力画像情報の特徴量を算出する特徴量算出手段と、

前記算出した特徴量と合致する特徴量を有する画像情報を、データベースから検索し、この検索によって見いだされた画像情報が表す状態の属性情報を、前記データベースから読み出す検索手段と、

前記読み出した属性情報を出力する属性情報出力手段と、

を含むことを特徴とする画像識別装置。

１４．画像情報と、前記画像情報が表す状態の属性情報と、前記画像情報の特徴量と、を格納するデータベースと、

与えられた入力画像情報の特徴量を算出する特徴量算出手段と、

前記算出した特徴量と合致する特徴量を有する画像情報を、前記データベースから検索し、前記検索によって見いだされた画像情報が表す状態の属性情報を、前記データベースから読み出す検索手段と、

前記読み出した属性情報を出力する属性情報出力手段と、

を含むことを特徴とする画像識別装置。

１５．請求の範囲１３又は１４記載の画像識別装置において、

所定の状態を表す画像情報を生成するディジタルカメラ手段、

を備え、前記ディジタルカメラ手段が、前記入力画像情報を生成することを特徴とする画像識別装置。

１６．請求の範囲１３又は１４記載の画像識別装置において、

前記状態は、靴の足跡を表す地表面、路面又は床面の状態であり、前記属性情報には少なくともその靴の製造会社名が含まれていることを特徴とする画像識別装置。

１７．請求の範囲１３又は１４記載の画像識別装置において、

前記状態は、医療検査結果であり、前記属性情報には少なくとも診断結果が含まれていることを特徴とする画像識別装置。

１８．請求の範囲１７記載の画像識別装置において、

前記画像情報は、レントゲン写真を表す画像情報であることを特徴とする画像識別装置。

１９．物体を表す画像情報と、前記画像情報が表す物体の属性情報と、前記画像情報の特徴量と、を格納する記憶手段と、

前記特徴量をキーとして前記画像情報を検索する検索手段と、

を含むことを特徴とするデータベースシステム。

２０．状態を表す画像情報と、前記画像情報が表す状態の属性情報と、前記画像情報の特徴量と、を格納する記憶手段と、

前記特徴量をキーとして前記画像情報を検索する検索手段と、

を含むことを特徴とするデータベースシステム。

２１．物体を表す画像情報と、前記画像情報が表す物体の属性情報と、前記画像情報の特徴量と、を格納したことを特徴とする記録媒体であって、前記特徴量を

キーとして前記画像情報を検索しうることを特徴とするコンピュータ読み取り可能な記録媒体。

２２．状態を表す画像情報と、前記画像情報が表す状態の属性情報と、前記画像情報の特徴量と、を格納したことを特徴とする記録媒体であって、前記特徴量をキーとして前記画像情報を検索しうることを特徴とするコンピュータ読み取り可能な記録媒体。

２３．請求の範囲１、２、１３又は１４記載の画像識別装置において、

所定の記録媒体から前記入力画像情報を読み出す記録媒体読み出し手段、

を備え、前記特徴量算出手段は、前記記録媒体から読み出した前記入力画像情報の特徴量を算出することを特徴とする画像識別装置。

２４．請求の範囲２３記載の画像識別装置において、

前記記録媒体は、ディジタルカメラ手段によって画像情報を書き込まれることが可能な記録媒体であることを特徴とする画像識別装置。

２５．請求の範囲１、２、１３又は１４記載の画像識別装置において、

所定の通信回線から前記入力画像情報を受信する画像受信手段、

を備え、前記特徴量算出手段は、前記画像受信手段が受信した前記入力画像情報の特徴量を算出することを特徴とする画像識別装置。

２６．請求の範囲２５記載の画像識別装置において、

前記属性情報出力手段が出力した属性情報を、前記通信回線を介して送信する属性情報送信手段、

を含むことを特徴とする画像識別装置。

２７．請求の範囲２５記載の画像識別装置において、

前記画像受信手段は、

前記通信回線から電子メールを受信し、その電子メールに含まれる前記入力画像情報を抽出する電子メール受信手段、

を含むことを特徴とする画像識別装置。

２８．請求の範囲２６記載の画像識別装置において、

前記画像送信手段は、

前記属性情報出力手段が出力した属性情報を含む電子メールを、前記通信回線

を介して送信する電子メール送信手段、

を含むことを特徴とする画像識別装置。

２９．請求の範囲２５、２６、２７又は２８記載の画像識別装置において、

前記通信回線はインターネットであることを特徴とする画像識別装置。

３０．請求の範囲２５記載の画像識別装置において、

前記通信回線は移動体通信回線であり、

前記画像受信手段は、

前記移動体通信回線を介して、ディジタルカメラ手段から前記入力画像情報を受信する移動体端末受信手段、

を含むことを特徴とする画像識別装置。

３１．請求の範囲２６記載の画像識別装置において、

前記通信回線は、移動体通信端末によって通信を行う移動体通信回線であり、

前記画像送信手段は、

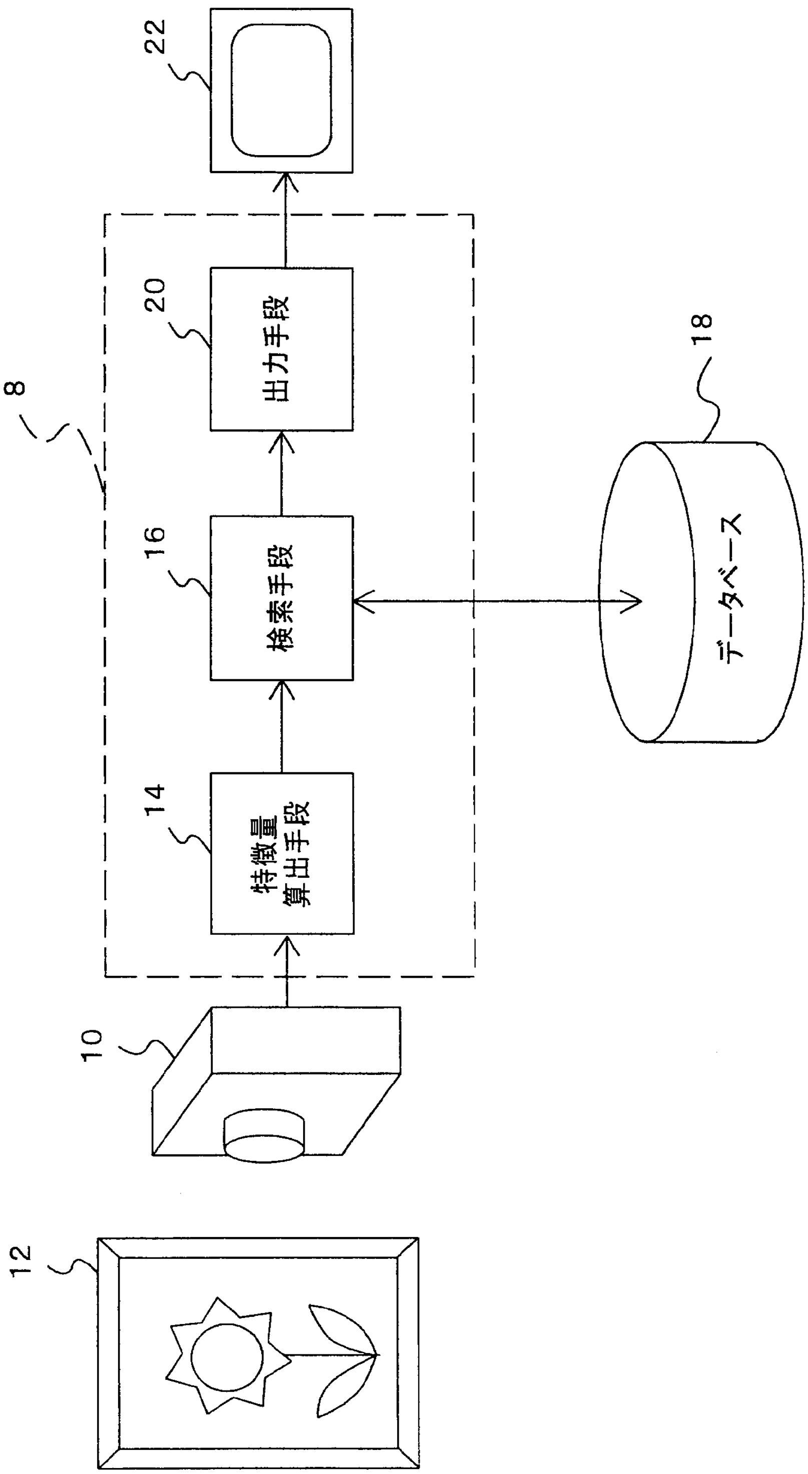
前記属性情報出力手段が出力した属性情報を、前記移動体通信回線を介して相手方の前記移動体通信端末に送信する移動体端末送信手段、

を含むことを特徴とする画像識別装置。

３２．請求の範囲３０又は３１記載の画像識別装置において、

前記移動体通信回線は、携帯電話通信回線であることを特徴とする画像識別装置。

図1



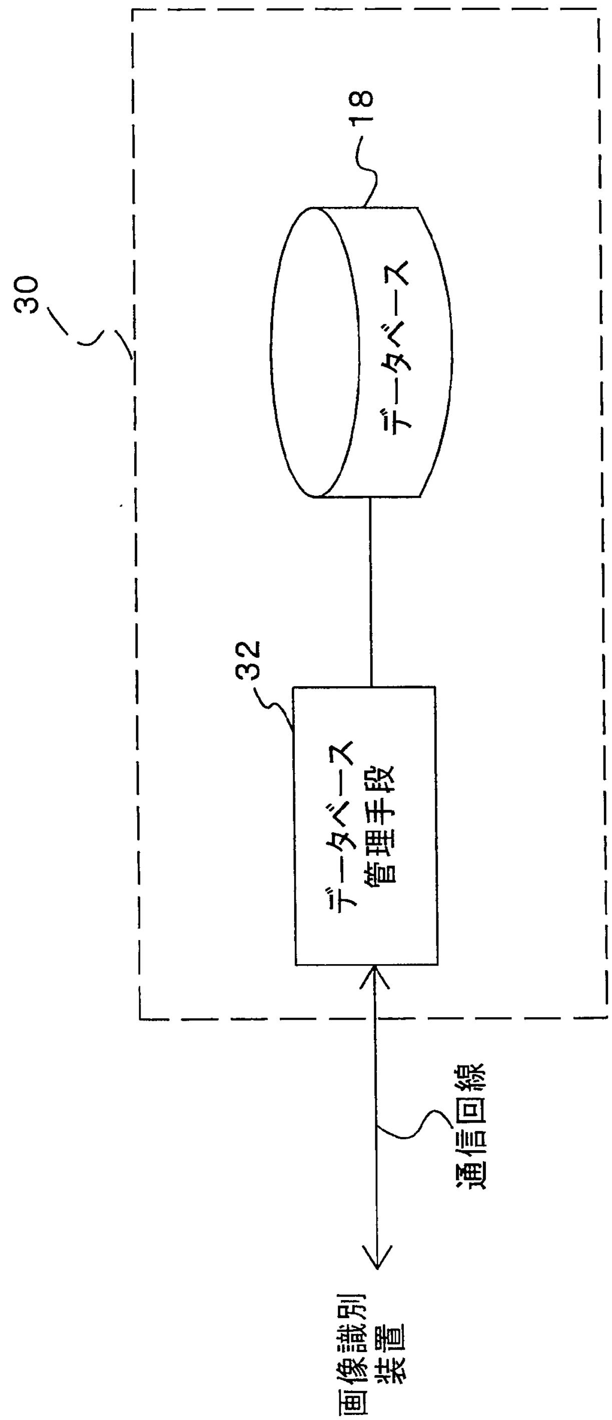


図2

図3

物体1の画像情報	特徴量	物体1の属性情報
物体2の画像情報	特徴量	物体2の属性情報
物体3の画像情報	特徴量	物体3の属性情報

インデックステーブル

特徴量
特徴量

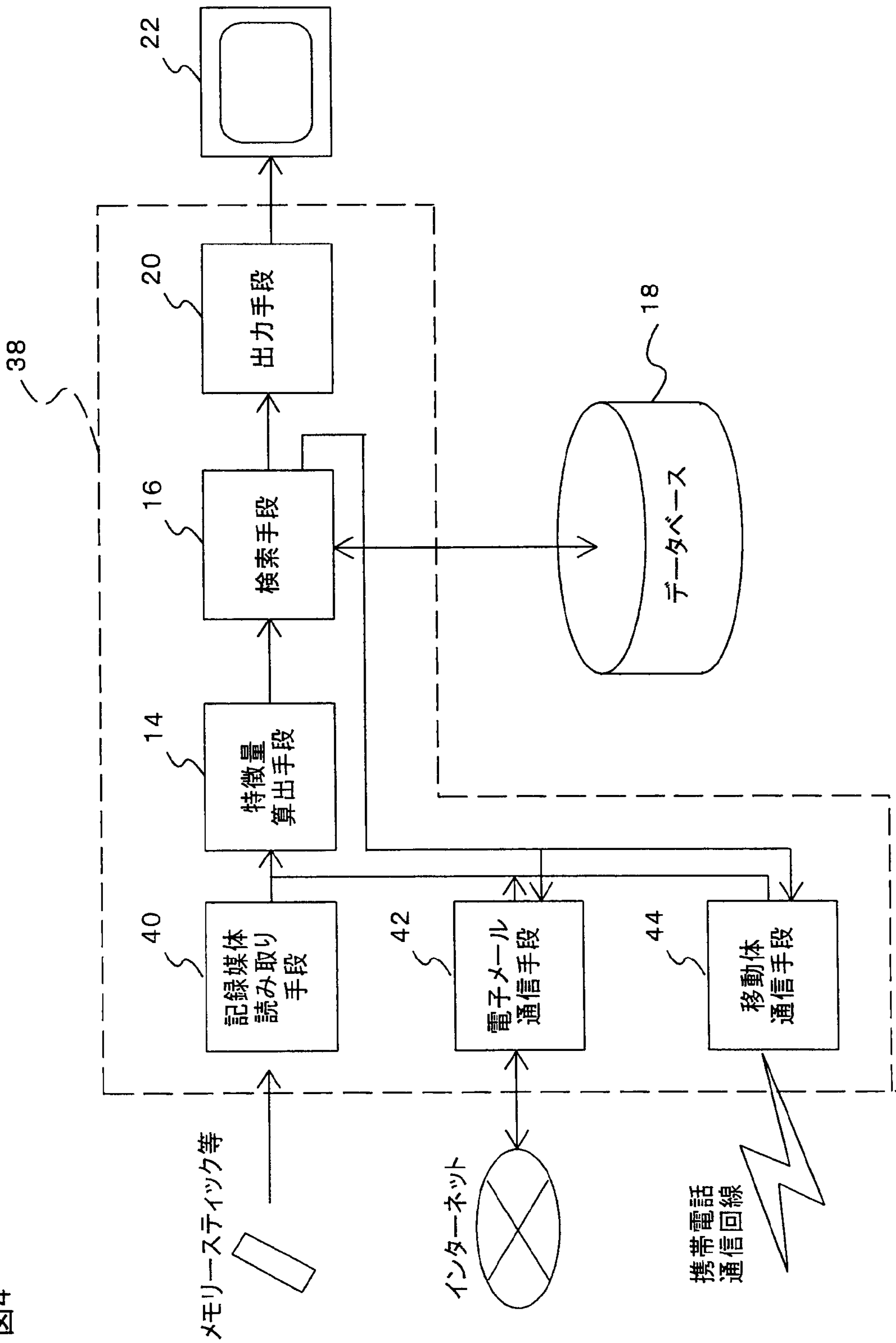

22
20
出力手段
38
16
検索手段
18
データベース
14
特徴量
算出手段
40
記録媒体
読み取り
手段
42
電子メール
通信手段
44
移動体
通信手段
メモリースティック等
インターネット
携帯電話
通信回線

図4

4／4

INTERNATIONAL SEARCH REPORT

International application No. PCT/JP00/03637

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl^7 G06F17/30, G06T1/00, G06T7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl^7 G06F17/30, G06T1/00, G06T7/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1926-1996	Jitsuyo Shinan Toroku Koho	1996-2000
Kokai Jitsuyo Shinan Koho	1971-2000	Toroku Jitsuyo Shinan Koho	1994-2000

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP, 10-091634, A (Hewlett-Packard Company), 10 April, 1998 (10.04.98), Full text (Family: none)	1-32
A	JP, 10-334117, A (Nissha Printing Co., Ltd.), 18 December, 1998 (18.12.98), Par. Nos. 35 to 36 (Family: none)	4-7, 17-18
A	JP, 10-275211, A (Sony Corporation), 13 October, 1998 (13.10.98), Par. No. 70 (Family: none)	8,16
A	JP, 05-242254, A (NTT Data Tsushin K.K.), 21 September, 1993 (21.09.93), Par. No. 3 (Family: none)	12
A	JP, 10-254901, A (OMRON CORPORATION), 25 September, 1998 (25.09.98), Full text (Family: none)	1-24
A	JP, 10-254903, A (OMRON CORPORATION), 25 September, 1998 (25.09.98),	1-24

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search 19 June, 2000 (19.06.00)	Date of mailing of the international search report 04 July, 2000 (04.07.00)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP00/03637

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Full text (Family: none)	
A	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No.80636/1991 (Laid-open No.4274/1993) (Hirohide FUSE), 22 January, 1993 (22.01.93) (Family: none)	1-24
A	JP, 11-88421, A (NEC Corporation), 30 March, 1999 (30.03.99), abstract (Family: none)	27-28

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

国際調査報告	国際出願番号　ＰＣＴ／ＪＰ００／０３６３７

A.　発明の属する分野の分類（国際特許分類（ＩＰＣ））

Ｉｎｔ．Ｃｌ^{7}　Ｇ０６Ｆ１７／３０，Ｇ０６Ｔ１／００，Ｇ０６Ｔ７／００

B.　調査を行った分野

調査を行った最小限資料（国際特許分類（ＩＰＣ））

Ｉｎｔ．Ｃｌ^{7}　Ｇ０６Ｆ１７／３０，Ｇ０６Ｔ１／００，Ｇ０６Ｔ７／００

最小限資料以外の資料で調査を行った分野に含まれるもの

日本国実用新案公報	１９２６－１９９６年
日本国公開実用新案公報	１９７１－２０００年
日本国実用新案登録公報	１９９６－２０００年
日本国登録実用新案公報	１９９４－２０００年

国際調査で使用した電子データベース（データベースの名称、調査に使用した用語）

C.　関連すると認められる文献

引用文献のカテゴリー＊	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求の範囲の番号
X	JP, 10-091634, A(ヒューレット・パッカード・カンパニー), 10. 4月. 1998(10. 04. 98), 全文（ファミリーなし）	１－３２
A	JP, 10-334117, A(日本写真印刷株式会社), 18. 12月. 1998(18. 12. 98), 第３５－３６段落（ファミリーなし）	４－７，１７－１８
A	JP, 10-275211, A(ソニー株式会社), 13. 10月. 1998(13. 10. 98), 第７０段落（ファミリーなし）	８，１６

☒ Ｃ欄の続きにも文献が列挙されている。　　☐ パテントファミリーに関する別紙を参照。

＊　引用文献のカテゴリー
「Ａ」特に関連のある文献ではなく、一般的技術水準を示すもの
「Ｅ」国際出願日前の出願または特許であるが、国際出願日以後に公表されたもの
「Ｌ」優先権主張に疑義を提起する文献又は他の文献の発行日若しくは他の特別な理由を確立するために引用する文献（理由を付す）
「Ｏ」口頭による開示、使用、展示等に言及する文献
「Ｐ」国際出願日前で、かつ優先権の主張の基礎となる出願の日の後に公表された文献
「Ｔ」国際出願日又は優先日後に公表された文献であって出願と矛盾するものではなく、発明の原理又は理論の理解のために引用するもの
「Ｘ」特に関連のある文献であって、当該文献のみで発明の新規性又は進歩性がないと考えられるもの
「Ｙ」特に関連のある文献であって、当該文献と他の１以上の文献との、当業者にとって自明である組合せによって進歩性がないと考えられるもの
「＆」同一パテントファミリー文献

国際調査を完了した日　１９．０６．００	国際調査報告の発送日　04.07.00
国際調査機関の名称及びあて先 日本国特許庁（ＩＳＡ／ＪＰ） 郵便番号１００－８９１５ 東京都千代田区霞が関三丁目４番３号	特許庁審査官（権限のある職員）　５Ｌ　９０７１ 平井　誠 電話番号　０３－３５８１－１１０１　内線　３５６０

様式ＰＣＴ／ＩＳＡ／２１０（第２ページ）（１９９８年７月）

Ｃ（続き）．　関連すると認められる文献

引用文献のカテゴリー＊	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求の範囲の番号
Ａ	JP, 05-242254, A(エヌ・ティ・ティ・データ通信株式会社), 21.9月.1993(21.09.93), 第３段落（ファミリーなし）	１２
Ａ	JP, 10-254901, A(オムロン株式会社), 25.9月.1998(25.09.98), 全文（ファミリーなし）	１－２４
Ａ	JP, 10-254903, A(オムロン株式会社), 25.9月.1998(25.09.98), 全文（ファミリーなし）	１－２４
Ａ	日本国実用新案登録出願３－８０６３６号（日本国実用新案登録出願公開５－４２７４号）の願書に添付した明細書及び図面の内容を記録したＣＤ－ＲＯＭ（布施宏英），２２．1月．１９９３（２２．０１．９３）（ファミリーなし）	１－２４
Ａ	JP, 11-88421, A(日本電気株式会社), 30.3月.1999(30.03.99), 要約（ファミリーなし）	２７－２８

(12)特許協力条約に基づいて公開された国際出願

(19) 世界知的所有権機関
国際事務局

(43) 国際公開日
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PCT

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WO 01/73603 A1

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(21) 国際出願番号: PCT/JP01/02582

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(25) 国際出願の言語: 日本語

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(30) 優先権データ:
特願2000-091012 2000 年3 月29 日 (29.03.2000) JP

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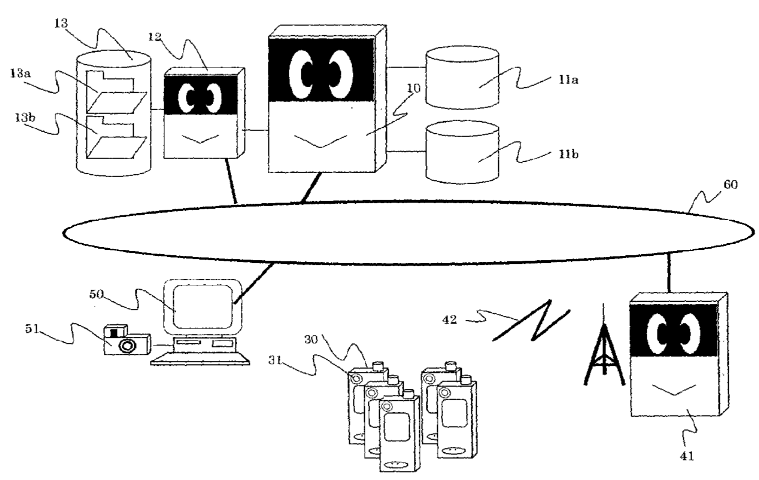
(81) 指定国 (国内): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) 指定国 (広域): ARIPO 特許 (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), ユーラシア特許 (AM,

[続葉有]

(54) Title: INFORMATION RETRIEVAL METHOD, INFORMATION RETRIEVAL SERVER AND PERSONAL DIGITAL ASSISTANT

(54) 発明の名称: 情報検索方法、情報検索サーバーおよび携帯端末



(57) Abstract: An information retrieval method using image recognition is provided that is suitable for personal or home use. When a user transmits image data produced using a camera (31) to a mail server (12) through a personal digital assistant (30), a reception folder (13a) of the mail server (12) stores electronic mail with an appended search image. A search server (10) separates the image data from the electronic mail to form an image key. The image key is compared with the standard pattern stored in a recording medium (11b) of the search server (10), and database registration information stored in a recording medium (11a) associated with the standard pattern is extracted and send to the personal digital assistant (30).

[続葉有]

WO 01/73603 A1

AZ, BY, KG, KZ, MD, RU, TJ, TM), ヨーロッパ特許 (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI 特許 (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

添付公開書類:
— 国際調査報告書

２文字コード及び他の略語については、定期発行される各*PCT*ガゼットの巻頭に掲載されている「コードと略語のガイダンスノート」を参照。

(57) 要約:

個人的または家庭的な利用に好適な、画像認識による情報検索方法を提供する。情報照会者がカメラ３１により撮影した画像データを携帯端末３０の送信機能によってメールサーバー１２に送信すると、この検索画像添付メールはメールサーバー１２の受信フォルダ１３ａに格納される。この画像データは、検索サーバー１０の機能によって電子メールより分離され、画像キーとなる。この画像キーは、検索サーバー１０の記録媒体１１ｂ内に格納された標準パターンと照合された後、標準パターンと関連付けられた記録媒体１１ａ内に格納されたデータベース登録情報が抽出され、当該抽出情報が携帯端末３０に返信される。

明 細 書

情報検索方法、情報検索サーバーおよび携帯端末

技術分野

本発明は、携帯端末を使用した情報検索方法に関し、特に、検索サーバーにおいて画像認識による情報検索を行わせ、その検索結果をネットワーク上から携帯端末にて取得することのできる情報検索方法に関するものである。

背景技術

従来、電子データベースの検索には、文字、記号等が検索キーとして用いられているが、近年になり画像を検索キーとすることも行われるようになってきた。このような画像認識による画像データベースは、各種工業、物流や医療の分野において、大きな成果を上げている。また、個人認証や防犯、地図などの分野にも普及しつつある。

しかしながら、これらの情報検索は大規模なシステムであったり、高額なシステムによって行われるものが殆どであり、個人的または家庭的に、手軽に利用可能なシステムとしては構成されていない。

例えば、酒、ワインなどの趣向品を入手または識別する際、現物があれば、文字情報を検索キーとして使用したり、あるいは検索コードを使用する検索よりも、現物を撮影した画像情報から直接そのワインに関する情報を得ることができるので、極めて便利である。

特に、ワインは世界中で生産され、ボトルに貼付されているエチケット（ラベル）は、各原産国語で記載されてあるばかりか、各国または各地区の法律や規則による記載方法が採用され、同じ名称で中身の違うものも多数存在するし、年代によって評価の異なることは周知の事実である。従って、ワインの鑑別には奥深い知識が必要となり、単に、エチケットに表示された文字を検索キーとしても、正確な情報を得ることは難しい。

発明の開示

本発明は、普及の著しいインターネットと携帯電話に代表される携帯端末を利用することにより、必要とするデータベース情報を簡単かつ手軽に取得することを解決課題とするものであり、個人的または家庭的な利用に好適な、画像認識による情報検索方法を提供するものである。

本発明の情報検索方法は、携帯端末から検索キーとしての画像データを検索サーバーに送信し、該検索サーバーは当該画像データから画像認識により標準パターンを識別し、該標準パターンに予め関連付けられているデータベース登録情報を前記携帯端末に応信することを特徴とするものである。

本発明の情報検索サーバーは、携帯端末から入手した画像データを入力パターンとし、内部に蓄積した標準パターンと比較する画像認識により、該標準パターンに予め関連付けられているデータベース登録情報を抽出し、該登録情報を前記携帯端末に応信することを特徴とするものである。

前記情報検索サーバーは、前記データベース登録情報と前記標準パターンを格納する記録媒体を有することが好ましい。また、前記携帯端末から送信される画像データをメールサーバーを介して入手することが好ましい。

本発明の携帯端末は、電子カメラを備え、該電子カメラにて撮影した画像データを情報検索サーバーに送信する手段と該情報検索サーバーからの電子メールを受信する手段とを有することを特徴とするものである。

図面の簡単な説明

図１は、本発明に係る携帯端末を使用した情報検索システムの全体説明図である。

図２は、入力パターンとしての画像キーの作成方法を示す説明図である。

図３は、検索サーバー１０の構成を示すブロック図である。

図４は、携帯端末３０の表示画面に示されるワイン情報の一例を示す。

発明を実施するための最良の形態

以下、本発明の好適な実施形態を、図面を参照しながら説明する。

図１は、本発明による携帯端末を使用した情報検索システムの全体説明図である。同図上段には画像認識による情報検索を行う検索サーバー１０と、この検索サーバー１０と外部間の電子メール送受信機能を担うメールサーバー１２が図示されている。検索サーバー１０の右側には、本情報検索システムの特徴部として検索サーバー１０の管理制御対象である、データベース登録情報が格納された記録媒体１１ａと、画像認識における「標準パターン」が格納された記録媒体１１ｂとを取り出して示している。

また、メールサーバー１２の左側に取り出して示されている記録媒体１３には、外部ネットワークから送信されて来る検索画像添付メールを受け入れるための受信フォルダ１３ａと、標準パターン添付メールを受け入れるための受信フォルダ１３ｂとが設けられている。なお、メールサーバー１２は検索サーバー１０と一体として設けてもよい。

符号３０、３０、・・・は、カメラ３１を具備した携帯端末であり、電波４２を介して、携帯端末３０、３０、・・・の信号をインターネット信号に変換する接続サーバー４１に接続されている。勿論、カメラ３１は携帯端末３０と一体として構成されてなくとも差し支えない。

固定端末５０は、標準パターンをネットワーク上から検索サーバー１０の記録媒体１１ｂに登録する目的で使用されるパソコン等であり、画像入力機器であるカメラ５１等を備えている。そして、上記検索サーバー１０、メールサーバー１２、接続サーバー４１、固定端末５０は、インターネット等のネットワーク網６０により接続されている。

本発明では、携帯端末３０の利用者（以下、照会者という。）が接続サーバー４１経由で検索サーバー１０内に蓄積されたデータベース登録情報を入手することができるものである。

図２は、入力パターンとしての画像キーの作成方法を示す説明図であり、同図には、調査の対象物２０とそれに貼られている識別用ラベル２１、カメラ３１付

きの携帯端末３０、画像キー（入力パターン）として送信されるデータのイメージ２３が描かれている。

先ず、照会者はカメラ３１により対象物２０の点線２２の範囲を撮影し、対象物２０の正面図２０ａと識別用ラベル２１の正面図２１ａとから構成されるイメージデータ２３を得る。このイメージデータ２３は、携帯端末３０の送信機能によって添付ファイルとしてメールサーバー１２に送信され、検索画像添付メール用の受信フォルダ１３ａに格納される。この画像データは、後述する検索サーバー１０の機能によって電子メールより分離され、画像キーとなる。この画像キーは、記録媒体１１ｂ内に格納された標準パターンと照合された後、標準パターンと関連付けられた記録媒体１１ａ内に格納されたデータベース登録情報が抽出され、当該抽出情報が携帯端末３０に返信される。

また、画像認識において標準パターンとなる画像データは、通常、検索サーバー１０内において作成・蓄積されるが、補助的には、外部からネットワーク６０を介して検索サーバー１０内に蓄積されてもよい。この場合、カメラ５１等を備える固定端末５０によって作成された標準パターン添付メールは、ネットワーク６０を介してメールサーバー１２の受信フォルダ１３ｂに格納され、当該画像データは、後述する検索サーバー１０の機能によって電子メールから分離され、標準パターン格納用の記録媒体１１ｂ内に格納される。上記外部からの標準パターンの蓄積作業は、検索サーバー１０における蓄積作業だけでは標準パターンの収集に限界がある場合に、特に有益である。

図３は、検索サーバー１０の構成を示すブロック図である。検索サーバー１０は、各種データに対する処理、入出力、送受信を行うために通常備えるべき構成部として、検索サーバー１０全体の動作を制御する制御部３２０と、データ処理を行う処理部３３０と、各種入出力装置及びネットワーク６０等に接続される入出力インターフェース３１０と、該入出力インターフェース３１０からデータを受け取る入力部３５０と、データを出力する出力部３６０と、データ処理の際に一時的にデータを記憶する記憶部３４０と、各種データを受信する受信部３７０と、各種データを送信する送信部３８０とを備えている。

検索サーバー１０は、前記通常備えるべき構成部に加えて更に、電子メールの送受信・転送機能を有するメーラー部３０００と、メールサーバー１２の受信フォルダ１３ａへの着信を常時監視する１３ａファイル監視部３００１と、画像添付メールを画像データとその他のデータとに分離する入力データ分離部３００２と、携帯端末の固有識別ＩＤやメールアドレスに関する登録データを蓄積したＩＤ蓄積部３００３と、該登録データを基にして検索サーバー１０自身の応答可否を判断するＩＤ判断部３００４と、検索キーとして入力された画像データに対して補正処理を行う入力パターン補正部３００５と、補正後の画像データから特徴パラメータあるいは特徴ベクトルを抽出する特徴抽出部３００６と、画像認識のための標準パターンを蓄積しておく標準パターン蓄積部３００７と、前記抽出された特徴量を標準パターンと対比した後、データベース情報蓄積部３０１２から、選定した標準パターンと関連付けられたデータベース情報を抽出する識別部３００８と、照会に対する応答情報を生成する応答情報生成部３００９と、前記応答情報の作成を通知する電子メールを生成するメール生成部３０１１と、メールサーバー１２の受信フォルダ１３ｂへの着信を常時監視する１３ｂファイル監視部３０１３と、リンク情報生成部３０１５とを備えている。

続いて、検索サーバー１０の作用を説明する。

携帯端末３０から発信された画像添付メールは、メールサーバー１２の受信フォルダ１３ａに受信され、当該受信は受信フォルダ１３ａへの着信を常時監視する１３ａファイル監視部３００１により検知されて、制御部３２０に報告される。報告を受けた制御部３２０は、処理部３３０に指示し、画像添付メールをメーラー部３０００を使用して、メールサーバー１２の受信フォルダ１３ａから入出力インターフェース３１０を経由して入力部３５０に入力させ、更に処理部３３０の指示により記憶部３４０に転送させる。

転送された画像添付メールは、入力データ分離部３００２によってメールアドレス、携帯端末の持つ固有の識別ＩＤ、画像データとその他のデータとに分離される。次に、分離された各データの中、携帯端末の持つ固有の識別ＩＤを基に、検索サーバー１０が応答しても良いかどうか判断する。即ち、前記固有の識別Ｉ

Dが、予めＩＤ蓄積部３００３に蓄積された登録データと一致するか否かがＩＤ判断部３００４により照合され、その結果が処理部３３０に報告される。

処理部３３０に応答許可の報告がなされると、前記分離された画像データは処理部３３０の指示を受けた入力パターン補正部３００５による補正処理を受ける。これは、入力パターンを標準パターンと照合する前に、入力パターンとしての画像データに含まれる情報の中で、識別に不必要な情報をできる限り取り除く作業であり、画像認識における認識精度と処理速度を向上させるための工程である。入力パターン補正部３００５によって補正された画像データは処理部３３０の指示を受けた特徴抽出部３００６によって特徴パラメータあるいは特徴ベクトルを求められる。特徴パラメータおよび特徴ベクトルとは、識別を行うのに有効なパターンの性質として、入力パターンから取り出されたデータである。

このようにして抽出された特徴量は、次に識別部３００８によって標準パターン蓄積部３００７（前出検索サーバー１０の記録媒体１１ｂに相当する。）の標準パターン（画像データ）を基に、どの標準パターンと合致するか、または、最も近いかが識別され、この標準パターンと関連付けられたデータベース情報蓄積部３０１２（前出検索サーバー１０の記録媒体１１ａに相当する。）のデータが処理部３３０に報告される。

上記報告を受けた処理部３３０は、応答情報生成部３００９に指示し、応答用のデータを生成させる一方、応答データが作成されたことを照会者に知らせる電子メールを作成するため、メール生成部３０１１に指示し、予め用意されたメッセージと生成された応答用のデータファイルの場所を記したＵＲＬを合成した電子メールを作成し、送信部３８０に転送する。転送されたメールデータは、電子メールとして入出力インターフェース３１０を経由してメールサーバー１２へ送られ、メールサーバー１２は、当該電子メールを照会した携帯端末３０に送信する。

携帯端末３０により上記メールを受信した照会者は、受信メール中で指定されたＵＲＬに応答用のデータを読みに行くことにより、例えば、図４の左半部に示す携帯端末３０の表示画面４０１に、図４の右半部に示すようなワイン情報４０

２を入手することができる。

なお、上記の説明では、メールサーバー１２は、応答データに関するＵＲＬを電子メールとして送信したが、データベース中の応答データを添付した電子メールを照会者宛に直接返信することも可能である。

前記したように、標準パターンとなる画像データは、通常方法に従い、検索サーバー１０内において作成・蓄積されるが、補助的作業としての外部からの標準パターンの蓄積作業について説明する。

検索サーバー１０に標準パターンを登録しようとする者（以下、登録者という。）は、固定端末５０の画面上から、本情報検索システムが指定するＵＲＬ画面に入り、指定されたパスワードチェックを経て、リンク情報生成部３０１５による指示画面に、送信したい標準パターン情報を入力した後、標準パターンのファイル名の発行を受ける。

次に、登録者は、前記発行されたファイル名を付した画像データを予め指定されたメールアドレスに送信する。この画像添付電子メールは、メールサーバー１２の標準パターン添付メール用の受信フォルダ１３ｂに格納される。該画像添付電子メールの受信は、受信フォルダ１３ｂへの着信を常時監視する１３ｂファイル監視部３０１３により検知されて、制御部３２０に報告される。報告を受けた制御部３２０は、処理部３３０に指示し、画像添付メールをメーラー部３０００を使って、該電子メールをメールサーバー１２の受信フォルダ１３ｂから入出力インターフェース３１０を経由して入力部３５０に入力させ、さらに処理部３３０の指示により、これを記憶部３４０に転送させる。

転送された画像添付メールは、入力データ分離部３００２によってメールアドレス、画像データとその他のデータに分離される。次に、分離された各データの中、メールアドレスについて、検索サーバー１０が受諾しても良いかどうか判断する。即ち、前記メールアドレスが、予めＩＤ蓄積部３００３に蓄積された登録データと一致するか否かがＩＤ判断部３００４により照合され、処理部３３０に報告される。処理部３３０に受諾の報告がなされた場合のみ、前記分離された画像データは処理部３３０の指示を受け、標準パターン蓄積部３００７に蓄積され

る。

本発明によれば、携帯電話に代表される携帯端末を利用することにより、必要とするデータベース情報を簡単かつ手軽に取得することができる。従って、酒、ワインなどの趣向品以外にも、動植物、鉱物、電機器械部品、日用品のパーツ、土木構造物、建築物、星座、その他、凡そ形のある物についての様々な情報の検索に幅広く適用することができる。また、本発明によれば、どの様な時間帯であっても、また、どの様な場所であっても、手元の携帯端末から検索サーバーにアクセスすることにより、直ちに欲する情報を入手することができるという優れた効果を有する。

請求の範囲

１．　携帯端末から検索キーとしての画像データを検索サーバーに送信し、該検索サーバーは当該画像データから画像認識により標準パターンを識別し、該標準パターンに予め関連付けられているデータベース登録情報を前記携帯端末に応信することからなる情報検索方法。

２．　携帯端末から入手した画像データを入力パターンとし、内部に蓄積した標準パターンと比較する画像認識により、該標準パターンに予め関連付けられているデータベース登録情報を抽出し、該登録情報を前記携帯端末に応信する情報検索サーバー。

３．　前記データベース登録情報と前記標準パターンを格納する記録媒体を有する請求項２記載の情報検索サーバー。

４．　前記携帯端末から送信される画像データをメールサーバーを介して入手する請求項２または請求項３記載の情報検索サーバー。

５．　電子カメラを備えた携帯端末であって、該電子カメラにて撮影した画像データを情報検索サーバーに送信する手段と該情報検索サーバーからの電子メールを受信する手段とを有する携帯端末。

図 1

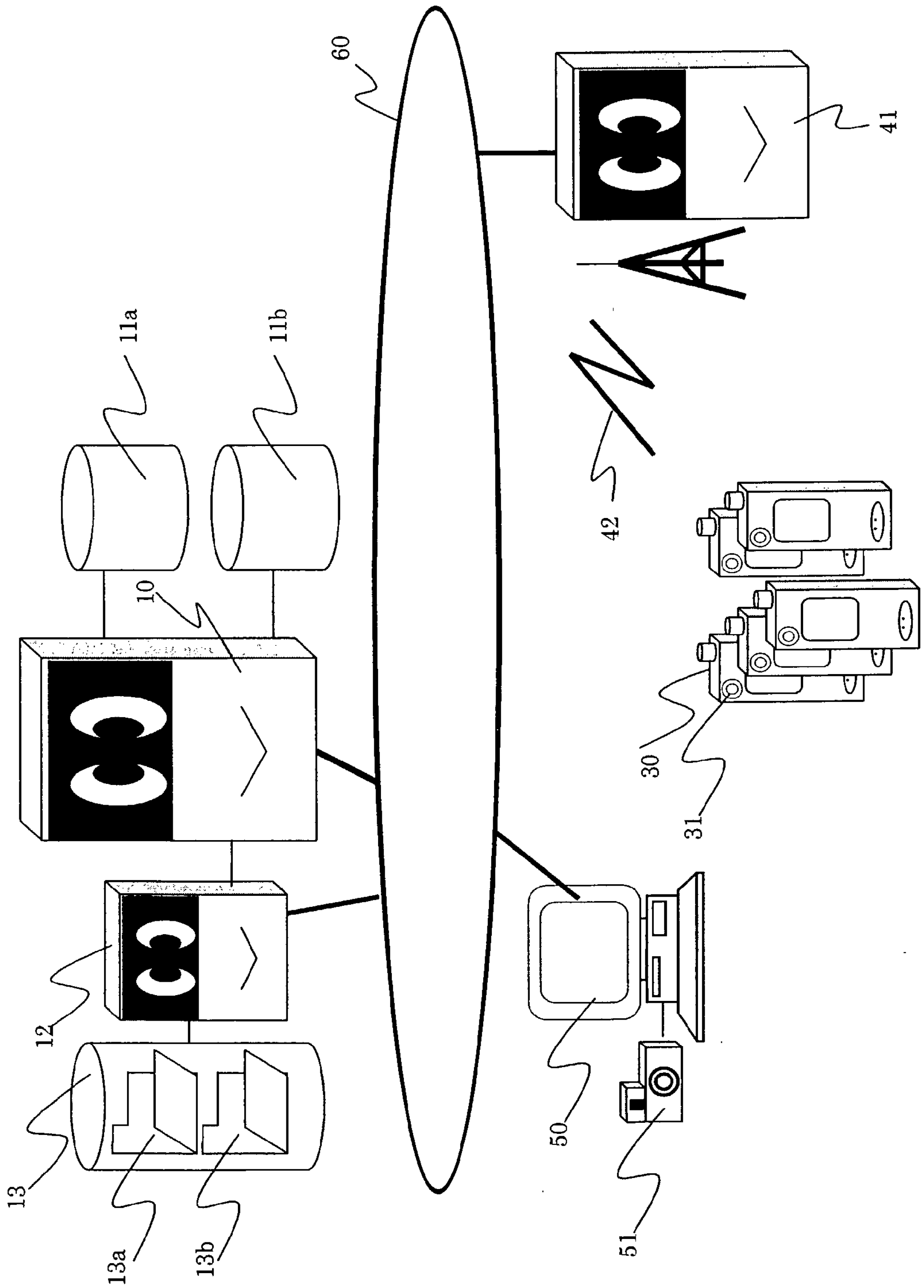


図 2

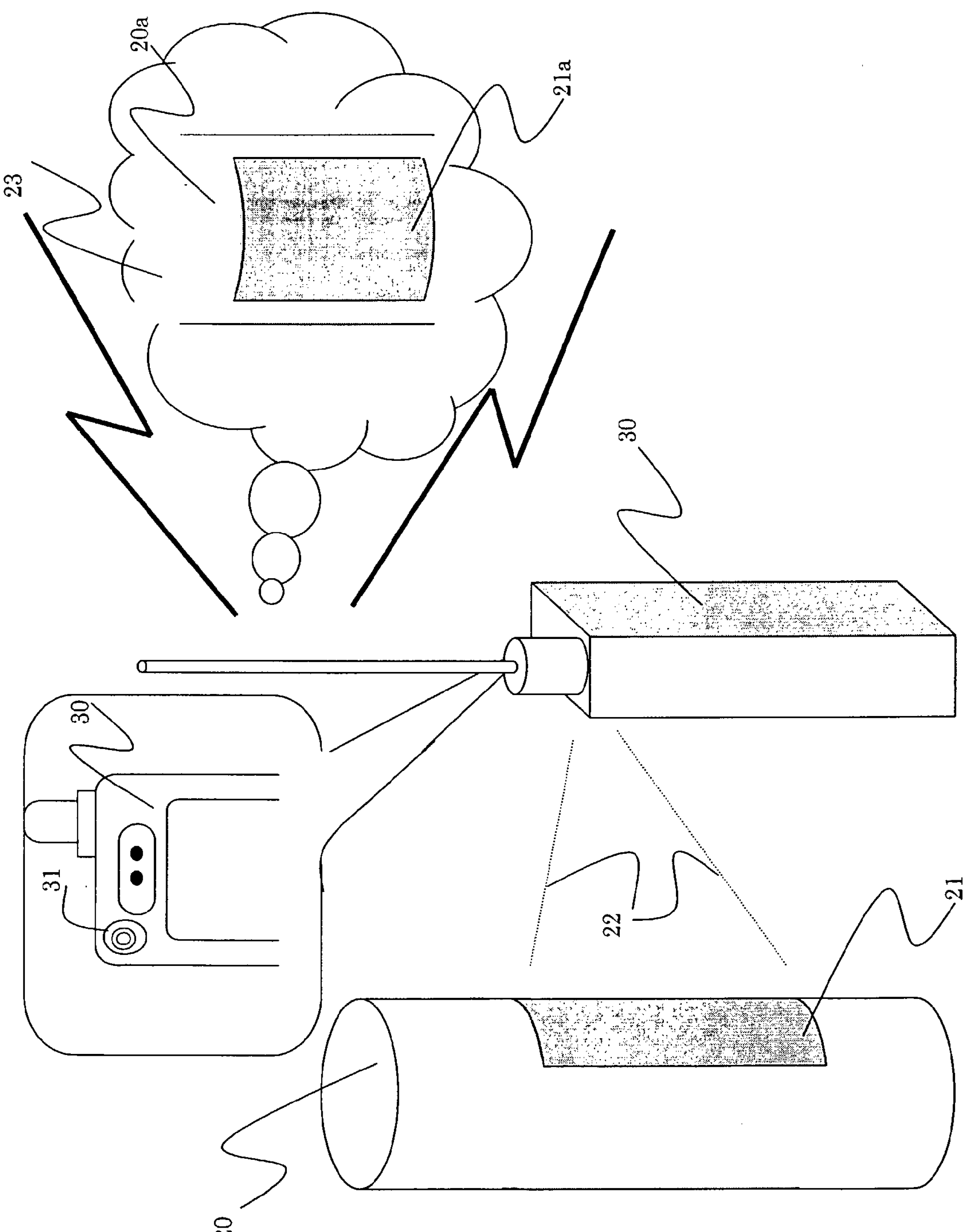
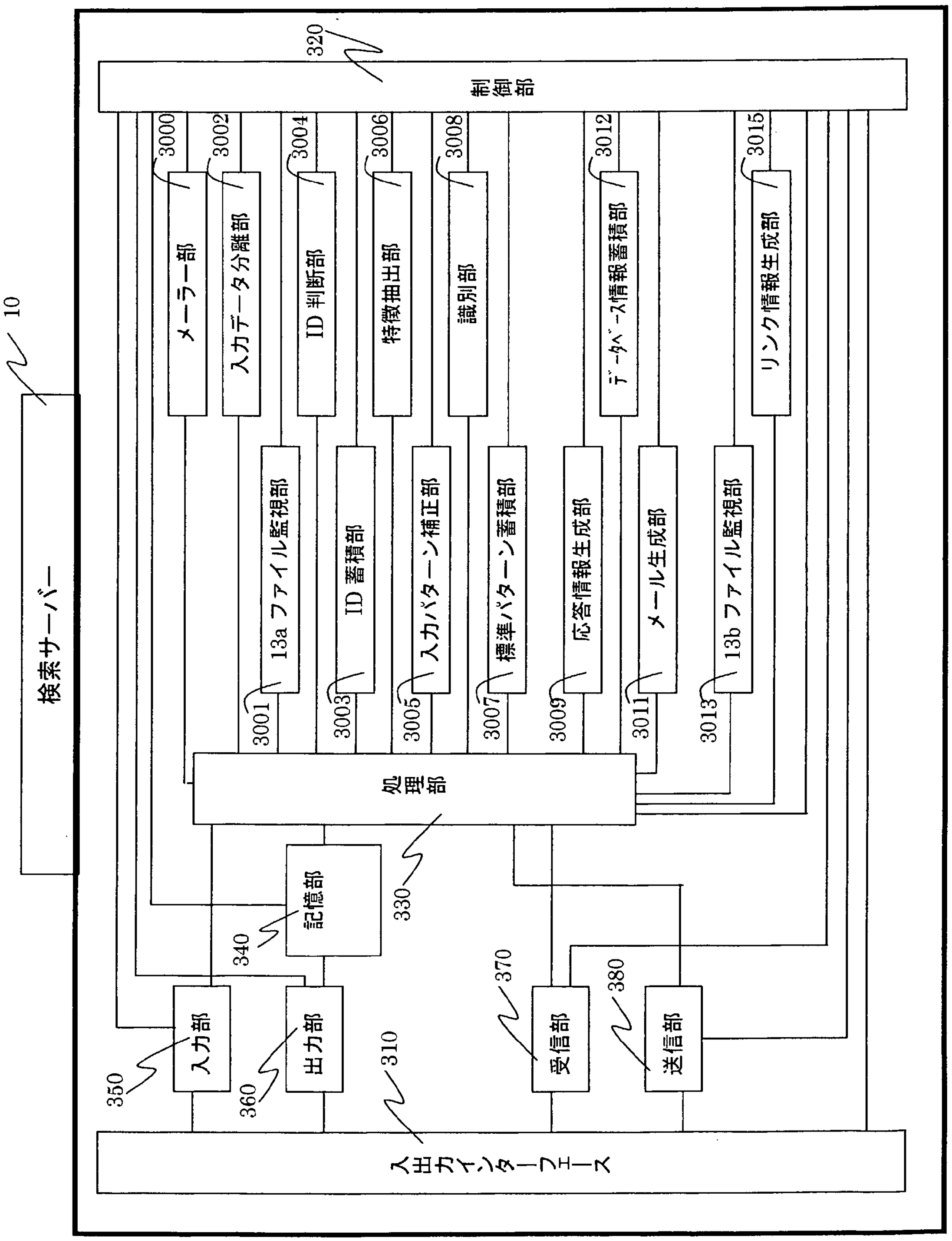


図 3



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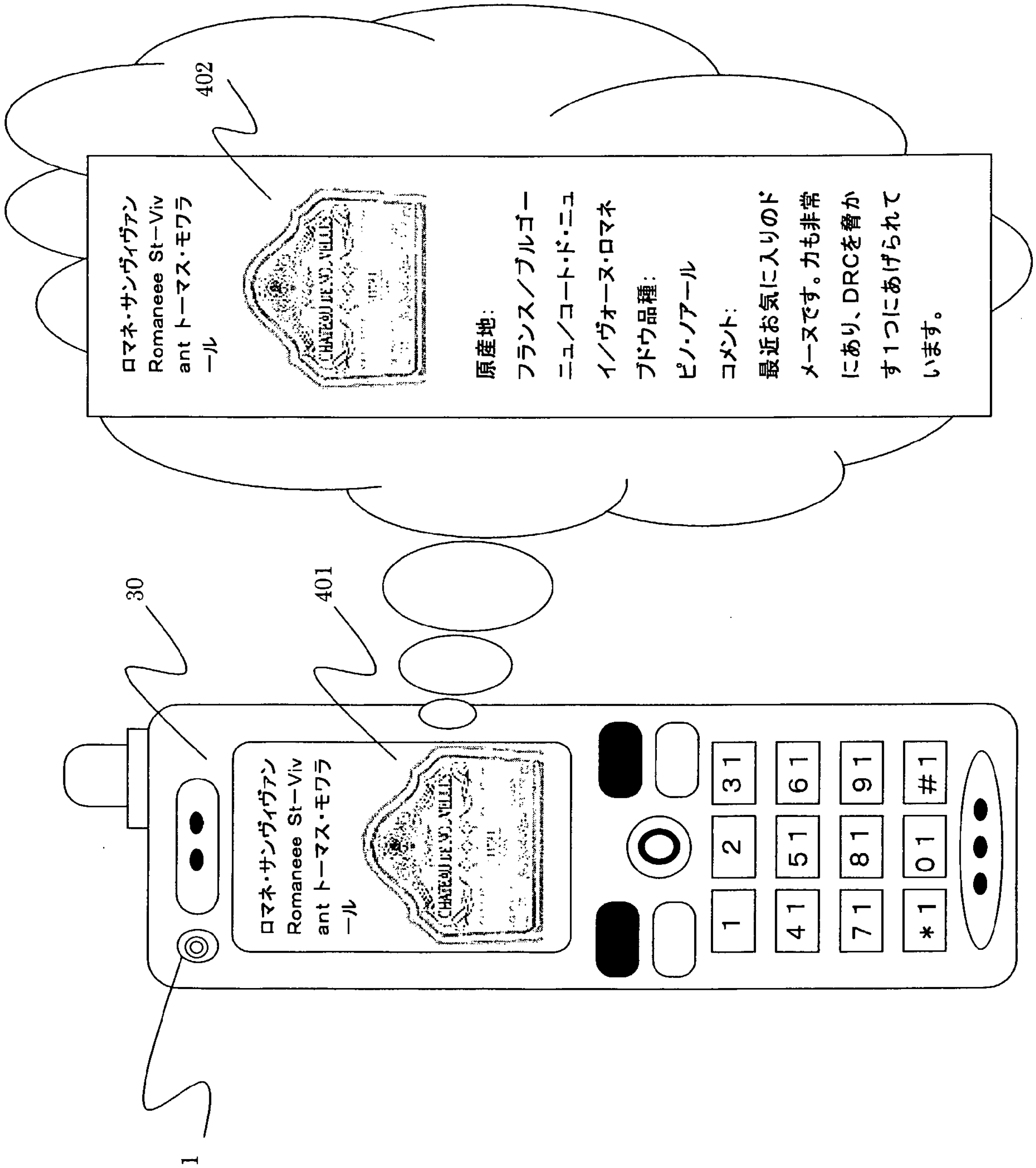
検索サーバー
320
制御部
3000
メーラー部
3002
入力データ分離部
3004
ID 判断部
3006
特徴抽出部
3008
識別部
3012
データベース情報蓄積部
3015
リンク情報生成部
13a ファイル監視部
3001
ID 蓄積部
3003
入力パターン補正部
3005
標準パターン蓄積部
3007
応答情報生成部
3009
メール生成部
3011
13b ファイル監視部
3013
処理部
330
記憶部
340
入力部
350
出力部
360
受信部
370
送信部
380
310
入出力インターフェース

図 4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ロマネ・サンヴィヴァン Romaneee St−Viv ant トーマス・モワラール
CHATEAU DE ST. VELLE
原産地:
フランス/ブルゴーニュ/コート・ド・ニュイ/ヴォーヌ・ロマネ
ブドウ品種:
ピノ・ノアール
コメント:
最近お気に入りのドメーヌです。力も非常にあり、DRCを脅かす1つにあげられています。
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ロマネ・サンヴィヴァン Romaneee St−Viv ant トーマス・モワラール
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/02582

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl^7 G06F17/30, H04M11/00, H04N5/76, 5/91, 7/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl^7 G06F17/30

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Toroku Jitsuyo Shinan Koho 1994-2001
Kokai Jitsuyo Shinan Koho 1971-2001 Jitsuyo Shinan Toroku Koho 1996-2001

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP, 10-289243, A (Casio Computer Co., Ltd.), 27 October, 1998 (27.10.98), Par. Nos. 13 to 17 (Family: none)	1-5
A	JP, 10-91634, A (Hewlett-Packard Company), 10 April, 1998 (10.04.98), Full text (Family: none)	1-5
A	JP, 11-88421, A (NEC Corporation), 30 March, 1999 (30.03.99), abstract (Family: none)	4-5

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 April, 2001 (17.04.01)	01 May, 2001 (01.05.01)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

国際調査報告

国際出願番号　ＰＣＴ／ＪＰ０１／０２５８２

Ａ．　発明の属する分野の分類（国際特許分類（ＩＰＣ））

Ｉｎｔ．Ｃｌ^{7}　Ｇ０６Ｆ１７／３０，Ｈ０４Ｍ１１／００，Ｈ０４Ｎ５／７６，５／９１，７／１４

Ｂ．　調査を行った分野

調査を行った最小限資料（国際特許分類（ＩＰＣ））

Ｉｎｔ．Ｃｌ^{7}　Ｇ０６Ｆ１７／３０

最小限資料以外の資料で調査を行った分野に含まれるもの

日本国実用新案公報	１９２２－１９９６年
日本国公開実用新案公報	１９７１－２００１年
日本国登録実用新案公報	１９９４－２００１年
日本国実用新案登録公報	１９９６－２００１年

国際調査で使用した電子データベース（データベースの名称、調査に使用した用語）

Ｃ．　関連すると認められる文献

引用文献のカテゴリー＊	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求の範囲の番号
Ｘ	ＪＰ，１０－２８９２４３，Ａ（カシオ計算機株式会社），27.10月.1998(27.10.98),13-17段落（ファミリーなし）	１－５
Ａ	ＪＰ，１０－９１６３４，Ａ（ヒューレット・パッカード・カンパニー），10.4月.1998(10.04.98), 全文（ファミリーなし）	１－５
Ａ	ＪＰ，１１－８８４２１，Ａ（日本電気株式会社），30.3月.1999(30.03.99),要約（ファミリーなし）	４－５

☐ Ｃ欄の続きにも文献が列挙されている。　　☐ パテントファミリーに関する別紙を参照。

＊　引用文献のカテゴリー
「Ａ」特に関連のある文献ではなく、一般的技術水準を示すもの
「Ｅ」国際出願日前の出願または特許であるが、国際出願日以後に公表されたもの
「Ｌ」優先権主張に疑義を提起する文献又は他の文献の発行日若しくは他の特別な理由を確立するために引用する文献（理由を付す）
「Ｏ」口頭による開示、使用、展示等に言及する文献
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特許庁審査官（権限のある職員）　５Ｍ　９０７１
平井　誠

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(54) Title: A METHOD FOR SELECTIVE IMAGE ACQUISITION AND TRANSMISSION

(57) **Abstract:** A method of transmitting an image is disclosed. The method comprises transmitting from a mobile imaging device an entire image at a first resolution. The transmitted image is received and characteristics patterns contained therein are determined. An appropriate imaging algorithm is selected in accordance with the determined characteristic patterns. The mobile imaging device is commanded to re-transmit certain portions of the entire image in accordance with the selected imaging algorithm. Finally the certain portions are retransmitted from the mobile imaging device at a second resolution, which is substantially higher than said first resolution.

A METHOD FOR SELECTIVE IMAGE ACQUISITION AND TRANSMISSION

Introduction:

The invention is that the sequential transmission of images stored on a client system could include redundant information. In order to minimize transmission time and volume, a system is proposed where the portable imaging device, connected to a remote server by means of either a wired or wireless data connection, is instructed by the remote server which images or video sequences to transmit, and what the resolution should be for each transmission.

The invention operates in this manner: The portable device sends one or more low quality transmissions, sufficiently detailed to allow the remote server to identify the image but not sufficiently to require a full transmission of all data. On the basis of this preliminary transmission, the server then determines the required data, computes the next sequence of transmission to transmit this data, and then commands the portable device to perform these transmissions. The portable device transmits the required data, and the remote server then constructs the final information required on the basis of the second sequence of transmissions. This is not an image compression scheme in the sense of replacing data blocks with tokens; rather it is a method for sending only the data necessary for task completion.

The data is not necessarily stored in a format that requires less space than usual. The primary data that is sent is not sufficient for extraction of the entire required data, but is sufficient for determination of the area containing the data of interest. Since the area of interest is expected to be a small portion of the entire image, the data of the area of interest is than transmitted in a detailed format.

Title of invention:

Selective transmission method for images and video.

Field of invention:

The invention relates to an image acquisition and communication device and a client-server system.

What's the problem?

Current situation of portable imaging devices with a data connection: the devices are typically composed of a camera, a storage media which is either non-volatile (e.g. flash memory, hard disk) or volatile (RAM), some image processing capabilities (e.g. compression, color interpolation) and data transmission capabilities (e.g. a modem, a data connection to a cellular phone, etc.). Some of these devices support image compression to reduce data transmission time and cost. We mention here Photovity from Flashpoint, the new Polaroid camera with a modem (PDC-640M) and the Lightsurf solution, etc. These devices are designed for the transmission of images taken by a digital camera using a data connection. They are designed to transmit the images taken previously by the camera either sequentially (until all the images have been uploaded) or based on user selection (that is the user chooses which pictures to upload).

For certain applications, such as document imaging, panoramic imaging, product imaging, the imaging of a symbol to be decoded (e.g. a bar code, a piece of text), the imaging device may take many more images than are required to be transmitted. Since data transmission is costly, takes up time and device battery power, there is a need to minimize the amount of data transmitted.

There are two options for reduction of the transmitted data: System 1. The imaging process is not controled. Redundant information is aquired and stored, but only the necessary information is transmitted. A portion of the data (e.g a small part of the images taken) is analysed. The analysis can be made in the imaging device or in a remote server. The result of both analysis is the selection of the necessary information to be transmitted. System 2: Control of the imaging process. The imaging process is changed in time according to analysis of the first images taken.

<u>Description of Samples of Prior Art:</u>
References 1 and 2, attached to this application, demonstrate some features of prior art, and the differences between the present invention and the prior art.

The concept of combining series ofimages into a single mosaic or panorama that covers a wider field of view, has better resolution or signal to noise ratio, and/or better dynamic range, is not new in itself. Reference 1 is an article describing some of the mathematical techniques for accomplishing such a type of "stitching" method. Reference 2 is an article describing some commercial products which enable taking panoramic images and/or performing the image "stitching".

Some of the novel aspects of the invention, in comparison to this prior art, are:
1) The concept of performing the imaging operation in a small portable device that is not necessarily optimized for imaging operation described herein. This is not a trivial problem of the prior art, since such small portable devices generally hold limited storage and limited data transmission capabilities. There are many assumptions inherent in prior art stitching processes, but these assumptions do not apply to and do not limit the current invention. For example, assumptions that are not required by the current invention but are required by prior art methods include:

a. The use of high resolution images. (See the images on pages 1282 and 1283 of Reference 1.)
b. The use of a high quality lens system with little optical distortion. (See the pictures on pages 1, 6 bottom, and 7, of Reference 2.)
c. Having the user perform a linear scanning motion with accurate image alignment due to the use of a view-finder on the device and due to the device being a camera rather than a cellular phone or a PDA.
d. The image being performed on objects that are relatively distant (a few meters, for example) from the imaging unit, and hence avoiding the very complex problem of finite distance image registration. (This assumption is mentioned as the "no parallax" issue in the Abstract on the first page of Reference 1, and also in several pages of the text of Reference 1.)

Since the current invention is not bound by these assumptions, it takes the concept of imaging and image stitching significantly beyond the prior art.

2) Currently, the computers and systems that perform image stitching and registration require the availability of the full set of images for performing the operation. For example, Reference 1 describes specifically a method for performing various kinds of correlation calculations on the whole image of the stitching process. Hence, if the stitching or registration is/are to be done at a later time (hence requiring intermediate storage of data), or in a different location (hence requiring transmission of the images), the full set of images must stored and/or transferred. This requirement will greatly burden the storage capacity of the portable device, or the data link capacity, or both. The current invention recognizes and makes use of the insight that not all of the information must be sent, but rather only portions of such data (with potentially reduced resolution, or other acceptable degradation) can be stored or sent. Further according to the current invention, only the critical images or critical image sections need to be retrieved in full resolution. This implementation is a major deviation from the method of operation according to the prior art.

<u>Description of the invention</u>: Figure 1 describes the prior art. Figures 2-4 inclusive describe the first embodiment of the invention, according to System 1 noted above. Figure 5 describes the second embodiment of the invention, according to System 1 noted above. Figure 6 describes the third embodiment of the invention, according to System 2 noted above.

Figure 1 (Prior Art): Possible known paths of communication between the system's elements

1. Element (1) is an imaging device. Element (2) is a device capable of saving the data. It can be embedded in element (1), or separate such as a portable device or a PC. Element (1) is connected to element (2) either through a wired data connection or wirelessly (a).

2. Element (3) is a server. Element (2) can be connected to element (3) in several ways:

* Element (2) is connected to a cell operator (b). The cell operator is connected to the Internet (c). The Internet is connected to element (3) (d).
* Element (2) is connected to the Internet (e). The Internet is connected to element (3) (d).
* Element (2) is connected directly to element (3) (f).

Figure 2,3,4 : Embodiment 1 (System 1): There will now follow a general description of Embodiment 1, then a detailed description of how the invention works with reference to the relevant Figures.

GENERAL DESCRIPTION OF EMBODIMENT 1: Embodiment 1 is the extraction of an area from a single picture without a prior knowledge of the object photographed. It involves the following stages of operation:

First, the entire first picture is sent in a low resolution.
Second, the type of the object is determined (document, headline in a news paper, barcode, etc).
Third, the relevant algorithm is performed. The algorithm determines what part of the picture is relevant and the minimal resolution necessary. For example: only the part containing the digits is extracted out of an image of a barcode. The extraction can be done using different methods, one of them is the folllowing: The image is first scanned for existence of lines. Some candidates areas having a line characteristic (e.g. rapid changes in a certain direction and minimal changes in the perpendicular direction) are selected. These candidates are examined further by, for example, computing moments in varying angles, the area size, etc. The most suitable candidate is chosen. The lines' direction is determined in a greated accuracy. The two possible locations of the digits relative to the lines (in the upper or lower part of the image) are examined and the correct one is determined. A simple OCR or ICR algorithm is used for recognition of the locations of the digits (without determination of the specific digit in each location). A line is matched to the location of the centers of the digits. The location of the center is corrected based on the rules of the digit's location inside a barcode (e.g equal distances between digits, number of digits in a barcode, etc.)
Fourth, the command flows back to element (2) and the required data is transmitted to the server (3).

DETAILED DESCRIPTION OF EMBODIMENT 1 WITH REFERENCE TO THE RELEVANT FIGURES:

Figure 2: Determination of the relevant algorithm for a given image for extraction of an area from it
Element (a): An image is aquired. The image can contain a barcode, headlines form a news paper, a text etc.
Element (b):The image is sent in low resolution.
Element (c): First the type of the required service is recognized. The basic algorithm deferentiates between services such as document imaging, panoramic imaging and product imaging. The identification can be made by searching for several characterizing patterns of each of the supported services in any given picture. For example any picture will be screened for lines of a bar code, headline format letters and a pattern of a text document.
Element (d): According to match results of the different patterns the relevant algorithm is chosen and performed. For example, if the format letters of a newspaper were detected, the algorithm for headline identification will be executed.

Figure 3:
Embodiment: Determination of the first data transition according to a priori knowledge of the object photographed

a. A notification about the photograph action is sent to element (3). (No part of the image which was collected is sent so far.)
b. The server (3) determines the type of the object. The decision can be based on a) location of the user b) time c) previous configuration made by the user d) previous use by the user. For example: if the user's is location is identified as a shop the product imaging is the default application.
c. The following parameters are determined according to the object: a) resolution b) the part of the picture to be sent (for example cutting 10% of the edges) c) number of pictures d) the most suitable pictures (for example the second, forth and last pictures are chosen rather than the first 3 ones).
d. The image is transmitted according to the transmission parameters detrmined in (c).

Figure 4,5: Examples for the operation of algorithm for extraction of an area from a single picture.

Figure 4: An algorithm for extraction of a headline area from a single picture of a newspaper.
If headline format letter were identified, the algorithm will be executed.
Element (a): The image is sent in low resolution. The entire area of the image is sent but in a limited information format.: low resolution, black and white instead of colors etc.
Element (b): The algorithm determines the location of all the candidate headlines in the image, and the candidate the user tried to photo, for example, according to its size and location in the image. The location of the part of interest in the original image is sent back
Element (c): The headline is sent to the server in a higher resolution than in (a).

Figure 5: An algorithm for extraction of a barcode's digits area from a single picture of a product
Element (a): The image is sent in low resolution. The entire area of the image is sent but in a limited information format: low resolution, black and white instead of colors etc.
Element (b): The algorithm determines the barcode's location, angle and direction. The location of the digits respected to the barcode is determined. The location of the digits in the original image is sent back.
Element (c). The digits are sent to the server in a higher resolution than in (a).

Figures 6: Embodiment 2 (System 1): There will now follow a general description of Embodiment 2, then a detailed description of how the invention works with reference to the relevant Figures.

GENERAL DESCRIPTION OF EMBODIMENT 2: Embodiment 2 is the extraction of non-redundant data from multiple pictures without a priori knowledge of the object photographed. It involves the following stages of operation:

First, a small portion of the pictures is sent in a low resolution.

Second, the algorithm determines what are the overlapping parts and if more pictures are required for stitching the entire document
Third, the additional pictures are sent in low resolution (if necessary).
Fourth, a stitching method is determined for the entire picture
Fifth, the non-redundant image data is transmitted in a higher resolution and stitched to create the entire image.

DETAILED DESCRIPTION OF EMBODIMENT 2 WITH REFERENCE TO THE RELEVANT FIGURES:

Figure 6: A stitching method using selective transmission
Element (a): The original object being photographed. The original images taken by element (1) from Figure 1, and stored in element (2) from Figure 1, can contain redundant information, as shown in element (a).
Element (b): The original images are sent to element (3) in Figure 1, in low resolution
Element (c): The redundancy between the images is determined.
Element (d):The pictures of interest and the area of interest inside these pictures are determined and the location data is transmitted back to element (2) in Figure 1. The relative location of each area, compared to the other parts needed for reconstruction of the original image (e.g. the stitching method), is determined and saved in element (3) of Figure 1.
Element (e): The areas of interest are sent to element (3) in Figure 1, in a higher resolution than in sub-section b of this paragraph. These parts are stitched together according to the stitching method determined in sub-section c of this paragraph.

Since embodiment 2 of the invention by its definition and nature requires the processing of multiple images, any application that requires the processing of multiple images will also be within the purview of the invention. For example, if multiple images are to made of the same target object, but at different times or from different angles of view, these may be stitched together, according to the invention, in order to achieve the desired result. For example, if images are to made of different target objects, whether there will be one image for each target or multiple images of each target, these images may taken and processed in accordance with the invention. Further, video is simply a combination of multiple images, processed at a certain rate of speed. Thus, video imaging is also application within the purview of the current invention. It will be appreciated that any application or usage that requires imaging of objects can be a subject of the current invention, particularly where the imaging must be transmitted in an accordance with a method where the communication bandwidth is limited.

Also, it is possible to take one image from a video, or other multiple image application, and improve upon that image by application of embodiment 1 of the invention. That is, the server can select one image that will be processed, then specify new values for imaging parameters for that one image, send these new values to the client, where the client will make a new image of the object and send that new image to the server. Other combinations are possible also.

Figure 7: Embodiment 3 (System 2): There will now follow a general description of Embodiment 3, then a detailed description of how the invention works with reference to the relevant Figures.

GENERAL DESCRIPTION OF EMBODIMENT 3: Embodiment 3 is the control of the imaging process. It involves the following stages of operation:

First, the first images are taken according to default parameters (such as, for example, exposure time, gamma factor, photographic frequency, total number of photos, storage format, etc). These images are sent to the server.
Second, the algorithm determines new values for the parameters in the imaging process. The parameters may include, for example, the number of pictures to be taken, the time differences between the next pictures, gamma correction, focus, etc. The algorithm also determines new values for the parameters in storage of the data. These parameters may include, for example, the format for storage, what parts of the images should be stored, what shall be the resolution of the image stored, etc.
Third, the next set of images are taken according to the new parameters.
Fourth, this process may be terminated after a predetermined number of sets of images have been taken by the client, transmitted by the client, and received by the server. (For example, the user may specify that there shall be only two rounds of images, or three rounds of images, or some other number.) Alternatively, the process may be repeated in an iterative manner until all of the necessary has been received at the server, without reference to a fixed number of rounds of transmissions. The "necessary" data is that amount and nature of data required to reconstruct the images in the quality required. In essence, the user determines the required quality, but does not limit number of rounds of transmissions, or the amount of data to be transmitted or processed. The manner in which the process is implemented, by number of rounds, amount of data, reqired quality, etc., may be varied by each application.

DETAILED DESCRIPTION OF EMBODIMENT 3 WITH REFERENCE TO THE RELEVANT FIGURES:

Figure 7: The control of the imaging process.

Element (a) The first images are taken according to default parameters (such as, for example, exposure time, gamma factor, photographic frequency, total number of photos, storage format, etc). The images are sent to the server in a limited information format, such as low resolution, white characters on black background, etc..
Element (b): The algorithm determines first, the parameters for the imaging process, such as, for example, number of pictures to be taken, the time differences between the next pictures, gamma correction, focus, etc.; and second, the parameters for storage of the data. The server then sends a message to the client, with specific parameters for the next set of images to be taken and transmitted to the server. In Figure 6, the example is that there changes in the time for image exposure, the compression ratio, and the gamma factor.
The next images are taken according to the new parameters. The next set of images is then sent to the server. It will be appreciated that this is an iterative process, with multiple rounds of images, refinements of the factors, and transmission of more images. The entire process allows the server to capture only the data required for the focus and quality required, while at the same time minimizing the total amount of data transmitted.

Embodiment 4: Combination of embodiments 1 and 3:
An additional embodiment 4 is the combination of embodiment 1 and embodiment 3 above. In this new embodiment 4, there are predetermined criteria for imaging at the client (in accordance with embodiment 3), and this image is sent to the server. The server then determines new values for the parameters, and sends these values to the client. The client takes a new image on the basis of the new values, and sends this image to the server. This process of imaging, transmission, determination of new values, etc., may be continued according to some predefined criteria such as number of rounds of images, quality of the picture desired, etc.

Embodiment 5: Combination of embodiment 2 and 3:
Embodiment 5 operates similarly to embodiment 4, except that with embodiment 5 there are multiple images taken per round of imaging, rather than one image only. For example, a user may want to create a panoramic image. The first images will be taken without a priori knowledge about the user's action, according to default parameters. The first images are sent in low resolution. The redundancy between the pictures is determined. According to the degree of redundancy, values such as the number of images, and the time lag between images, may be changed. The redundancy also determines which pictures and what part of the pictures will be used for the creation of the panoramic image.

Advantage of the invention over prior art:

The current invention reduce data transmission time and cost. Instead of a sequentially or user selected-based transmission of the image data, a selective transmission enables the transmission of the minimal amount of data required. A relevant area can be determined from a low-resolution image, and then extracted from a higher-resolution image. Alternatively, the location of non-redundant data can be determined using multiple low-resolution images. Then only the non-redundant data can be sent in higher resolution and stitched. The method can be combined with existing methods for data compression for minimization of transmission time and cost.

Innovative steps:

The novel items in the invention include:

1. A system where the imaging device transmits lower grade partial images to a server to facilitate image identification, and the server requests further image information (e.g. higher resolution portions, etc) to facilitate the desired action, such as image stitching, OCR etc.
2. A system where, instead of the server as described immediately above, a special algorithm running on the imaging device's processor performs the identification, and the decision is not which parts of the image(s) to transmit and how to transmit themm but rather how to store images for future usage/transmission.
3. A method where the server instructs the imaging device on camera and/or imaging specific parameters such as exposure time, camera AGC, camera gamma factor etc.
4. A method where the server provides the imaging device with information on the quality of the received picture and hence updates/controls the compression characteristics/algorithm parameters used in the compression algorithm on the imaging and data transmission device.
5. A system where the feedback about the imaging operation for the user (e.g. camera scan speed, camera distance from the object, image brightness, existence of letters/numerals/bar-codes in the image, object angle, etc.) is computed in the server and sent back to the imaging device to assist the user in the imaging operation.
6. A method for transmitting (or storing) only the part of the image that is critical for accomplishing the image recognition task – e.g. the headline in a newspaper, the numerals or bar-code in a UPC/EAN or other bar-code symbol, the new part of the picture revealed in the new picture etc.
7. A method for reconstructing an image from storage on the device or from the transmissions received on the server in such a way that the proper image identification/image sending/image display/image printing operation will be of sufficient quality. For example, for faxing a document the server may stitch together the relevant transmitted image portions, and for this stitching an 8-bit per pixel color depth may be necessary. For performing OCR on the same image, a 1 bit pixel depth (and stronger compression)_may be optimal. The novel principle is that there is no "one image" of a given resolution,size, color depth and with a given compression method. Rather, the image, as residing on the imaging device's volatile and/or non-volatile memory, is extracted and sent to the server with parameters reflecting the desired application and controlled by special software in the imaging device or the server.

Supplementary questions and answers about the invention:
1) Who are the inventors? *Tsvi Lev and Ofer Bar-Or.*
2) When was the invention conceived? *In November, 2000 at the offices of UCnGo in Ramat-Gan, Israel.*
3) What is the current stage of the invention, development, testing, marketing, etc.? *The invention is currently under implementation/development. (See the Fax SOW document, below.)*
4) Have any revelations been made about this invention to anyone outside the company? If so, what are the details of such revelations? *The invention was not revealed to anyone but company employees, existing investors, and our Special Counsel for Intellectual Property, Ariel Goldstein.*

File:uc101021.doc

References:
1. Steven Mann, member, IEEE, and Rosalind W. Picard, member IEEE, "Video Orbits of the Projective Group: A Simple Approach to Featureless Estimation of Parameters", IEEE Transaction On Imagging Processing, vol 6 no 9, September 1997.
2. The future Image Report, November 2000, volume 8 issue5

The two references listed above are incorporated herein by reference.

Appendix: The following appendix is an internal engineering document of UCnGo, the employer of the applicants. This document indicates parameters for implementation of the invention. It will be appreciated that this document is suggestive only. The invention is not limited to the criteria, the numbers, or the applications, stated herein. Nevertheless, the appendix suggests technical criteria and parameters that are part of the invention.

Fax Application Statement of Work (draft)

Application requirements:

General requirements

Fax application is designed to run on a portable platform connected to a remote server by a modem.
The application is designed to acquire a monochrome text image from A4-sized paper using a digital camera based on some embedded platform and reconstruct it as a readable binary or 4 gray-level image on the remote platform.
The amount of calculations to be performed on the portable platform is minimal, under the constraints of:

1. Minimal acquisition speed
2. Communication speed
3. User feedback

Based on requirement of approximately 100 frames per A4-sized paper, the minimal acquisition speed should be between .25 and .75 frames per second.
Communication speed dictates compressed image size to be approximately 3KByte per frame.
User feedback implies visual or auditory response TBD.

Mode of operation

The fax acquisition operation is performed by an ordinary user after short training. The user performs acquisition as smoothly as possible without any additional hardware.
The envelope of operation is

1. Distance between camera and paper: 7-15cm.
2. Maximal peak to peak variation on the distance for the entire scan: 2cm.
3. Maximal distance between two consecutive frames is 3cm.
4. The first 4 frames of the acquisition sequence will be used for extrinsic camera calibration and the distance between these frames should be between .25 and .75 cm.
5. The acquisition is performed in overlapping strips, so that there are 3-4 strips of 15-20 frames per A4 size page.
6. The transition between strips is smooth, so that 4-5 frames are required per transition.
7. Maximal pitch and roll angle is 7 degrees.
8. Maximal camera rotation is 30 degrees peak to peak for the entire acquisition process and 10 degrees between 2 consecutive frames.

Prior to acquisition intrinsic camera calibration is performed using a predefined (checkerboard) target. For the fixed focus cameras the calibration processed is performed once only.

Embedded hardware requirements

Programmable DSP processor: TBD ops
Digital camera with minimal resolution 320x240 pixels, TBD bits per pixel.
Minimal communication speed: 20KBps.

Remote server requirements

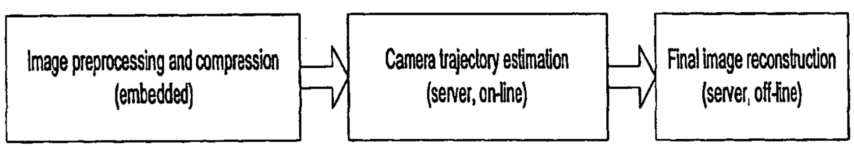
Minimal communication speed: 64KBps.
Maximal latency between 2 consecutive frames: .25sec.
Maximal total processing time: 200sec.
Hardware TBD.
Processing power requirements: TBD
(For the on-line processing a quad Pentium 1GHz computer with at least 256Mbyte memory is recommended.
For the off-line processing 16 computers or 4 quads with highly-parallel structure of multiple servers, 1GByte memory and fast connection is recommended)

Operational block-diagram

Processing stages

Total processing can be divided into 3 almost independent stages:

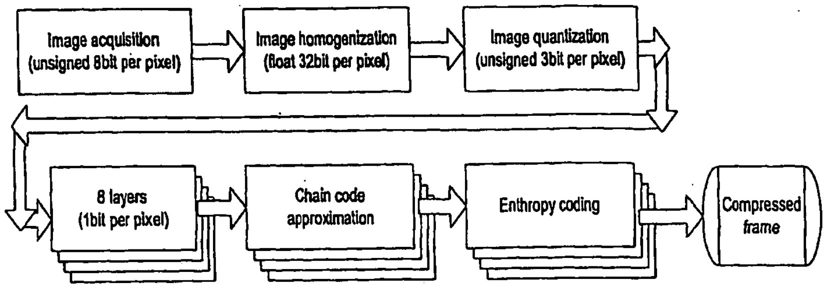
1. Image preprocessing and compression is performed on the embedded unit
2. On-line camera trajectory estimation on the remote server.
3. Off-line final image reconstruction on the remote server.



Note that different hardware is required for each processing stage.

Preprocessing and compression

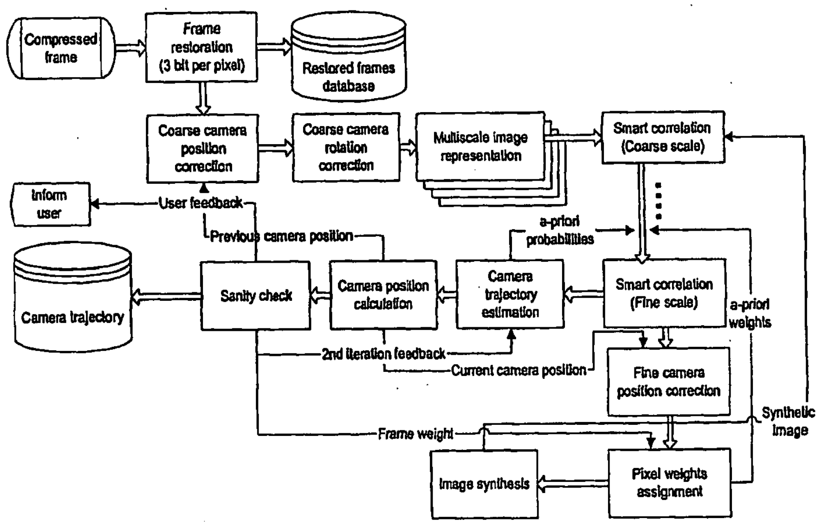
Since each frame size is 3KByte and a 320x240 image with 8bps takes approximately 72KByte, some dedicated preprocessing and compression is required in the embedded unit. The a-priory monochrome properties of the image can be used to minimize the compression artifacts, quantization effects and computational requirements in the following processing stages. Therefore the following operations are performed in the embedded unit:



The most time-consuming process in this flowchart is image homogenization, for which a floating point processor is required. Smart casting decreases significantly the number of floating point operations required to taking the power .25 of each pixels' statistic.

Camera trajectory estimation

The estimation of relative position of frames is crucial for the image reconstruction process. The user should receive a feedback regarding the camera movement in real time, so he can correct his mistakes. All the frames, their sanity scores and camera positions are saved in a database for final image reconstruction.

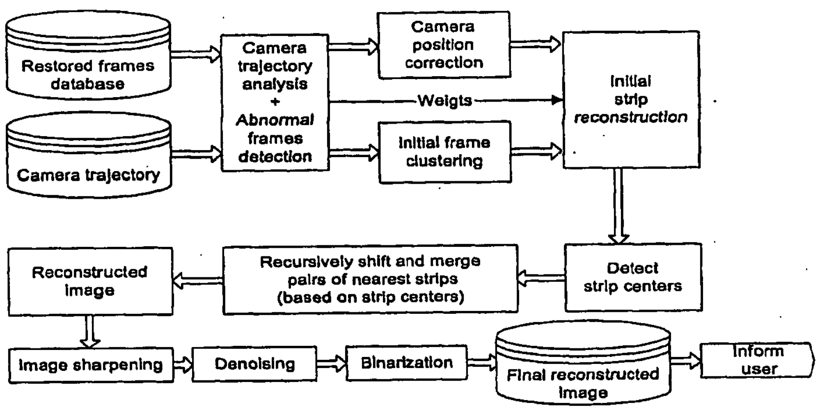


The pair-wise processing of the frames is based on a smart correlation procedure, which is performed in multi-scale setting for fast implementation. The relative position of the frames can be translated to camera trajectory and various deformations of the image provide an estimator for the camera position. Sanity check and various weight assignment allow to correct distortions caused by errors in camera position estimation. A temporary synthetic image is constructed to improve trajectory estimation.

Multiple feedbacks between various processes allows fast adaptation and on-line problem correction.
Real-time (.25 sec delay) feedback supplied to the user allows to correct problems caused by improper operation.

Final image reconstruction

The final image reconstruction is the most time-consuming stage of the process. It is based on acquisition sequence clustering into strips followed by recursive merging of the detected strips. This time-consuming process allows to correct problems caused by sequential frame acquisition and eliminates 'bad' frames.



The reconstructed image undergoes various resolution improvement procedures and final fax-like image is created. The user is informed on the success of the operation.

Development process

Parallel activities

The development process can be divided into various parallel activities:
1) Low-level image processing:
   a) Homogenization, b) Quantization and binarization, c) Compression and restoration, d) Image sharpening and denoising.
2) Smart multistage correlation computation with weight assignment:
3) Camera modeling
   a) Camera trajectory model, b)Camera rotation correction, c) Intrinsic camera calibration, d) Extrinsic camera calibration, e) Sanity check and trajectory analysis, f) Abnormal frames detection
4) Image synthesis
   a) On-line image synthesis, b) Frame clustering, c) Strip reconstruction, d) Recursive strip merge
5) Integration

CLAIMS

1. A method of transmitting an image, comprising:

transmitting from a mobile imaging device an entire image at a first resolution;

receiving said transmitted image and determining characteristic patterns contained therein;

selecting an appropriate imaging algorithm in accordance with the determined characteristic patterns;

commanding the mobile imaging device to re-transmit certain portions of the entire image in accordance with the selected imaging algorithm; and

re-transmitting from said mobile imaging device the certain portions of the entire image at a second resolution, which is substantially higher than said first resolution.

2. A method of transmitting an image, comprising:

transmitting from a mobile imaging device information about an image;

receiving said transmitted information, and determining characteristics about the image based on the information;

commanding said mobile imaging device to transmit selected portions of the image in accordance with the determined characteristics.

3. A method of transmitting a desired headline from a page of a newspaper, comprising:

transmitting from a mobile imaging device an image of the entire page of the newspaper at a first resolution;

identifying from the transmitted entire page of the newspaper the location of the desired headline in accordance with an algorithm;

sending to the mobile imaging device information representing the location of the desired headline;

re-transmitting the entire page of the newspaper, the desired headline of the newspaper being re-transmitted at a second resolution which is substantially higher than said first resolution.

4. A method of transmitting barcode's digits from a product image, comprising:

transmitting from a mobile imaging device a barcode from a product image at a first resolution;

identifying from the transmitted barcode, its location, angle and direction in accordance with an algorithm;

sending to the mobile imaging device information representing the location of the barcode's digits;

re-transmitting that portion of the barcode containing digits at a second resolution, which is substantially higher than said first resolution.

5. A method of transmitting an image, comprising:

sending from a mobile imaging device an image containing redundant information at a first resolution;

determining from the sent image overlapping portions thereof, and determining the desired location of the image;

sending information representing the determined desired location to said mobile imaging device;

re-sending desired portions of the image in according with the sent location information at a second resolution which is substantially higher than said first resolution;

stitching together the image based the desired portions of the image and based on the determined overlapping portions.

6. A method of transmitting an image, comprising:

transmitting an image taken by a mobile imaging device according to default parameters at a limited information format;

determining from the transmitted image the proper parameters for the image in accordance with an algorithm;

sending to said mobile imaging device information representing the determined proper image parameters; and

adjusting the image taken by the mobile imaging device according to said determined proper image parameters.

7. The method of claim 1, 3 or 4, wherein the re-transmitting step also includes re-transmitting at a higher/lower compression ratio or with a different compression algorithm.

8. The method of claim 5, wherein the re-sending step also includes re-sending at a higher/lower compression ratio or with a different compression algorithm.

Figure 1 :

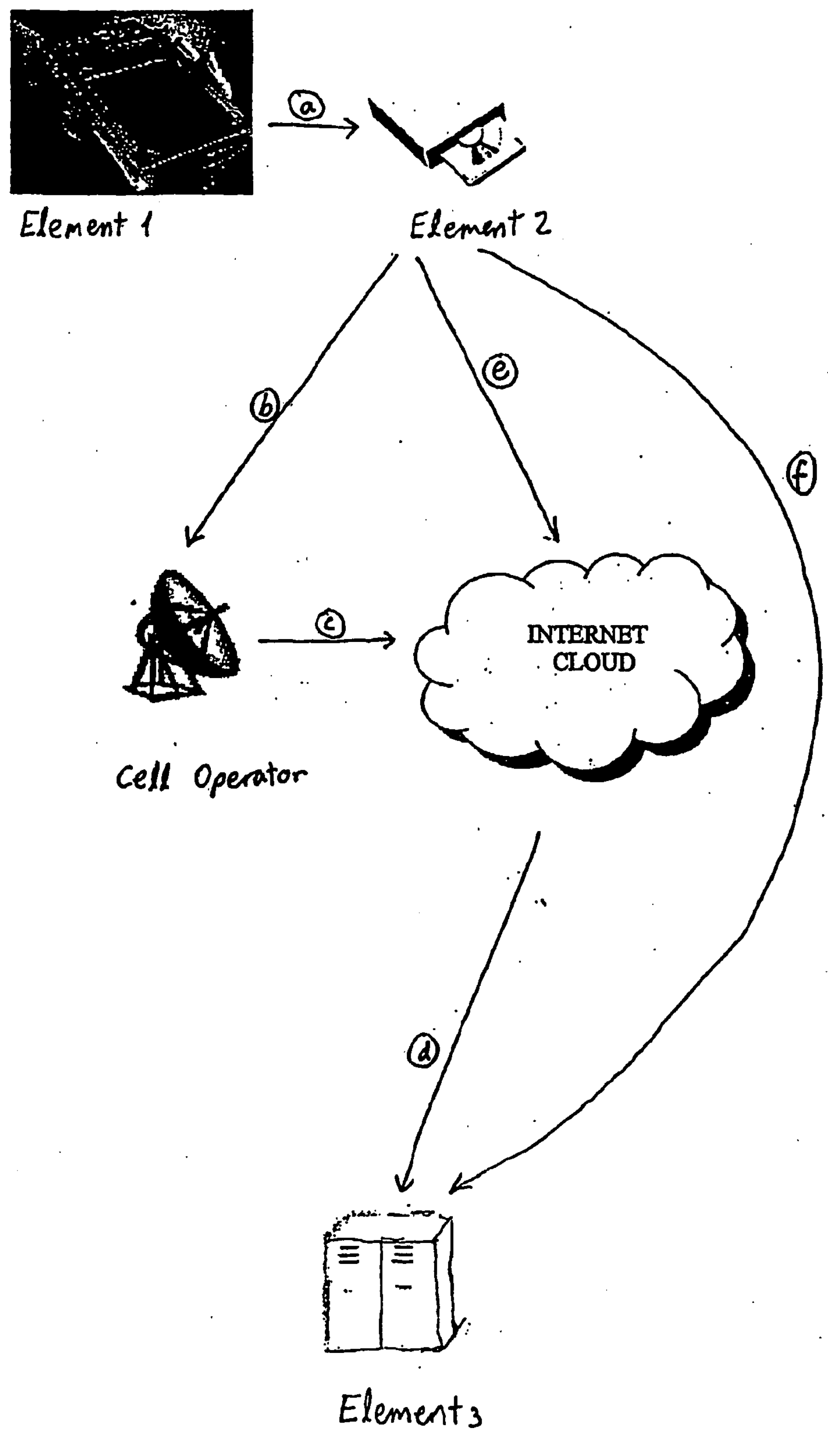

a
Element 1
Element 2
b
e
f
c
INTERNET CLOUD
Cell Operator
d
Element 3

FIG.2 Determination of the relevant algorithm for a given image for extraction of an area from it

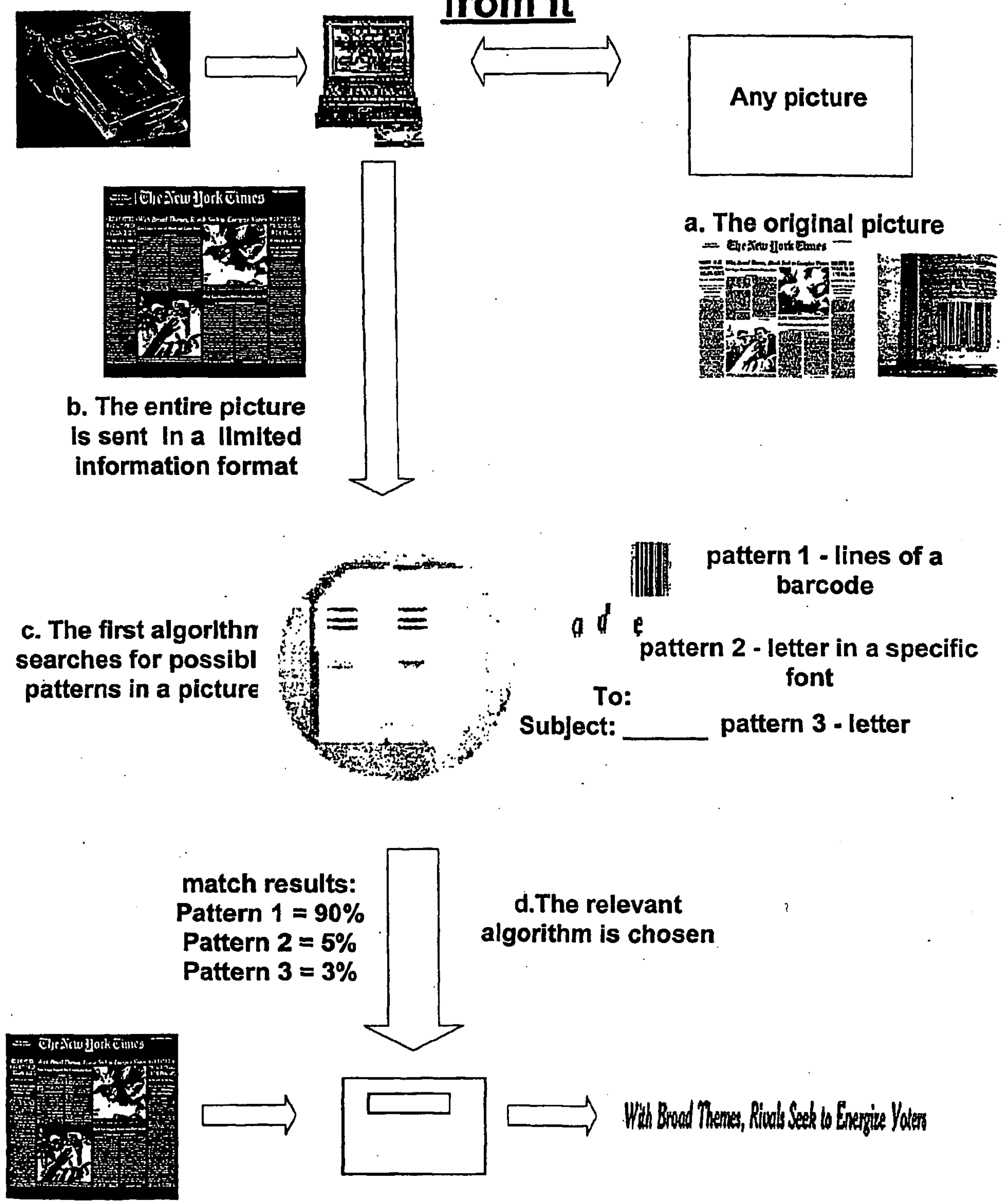


FIG.3 Determination of the first data transition according to a priori knowledge of the object photographed

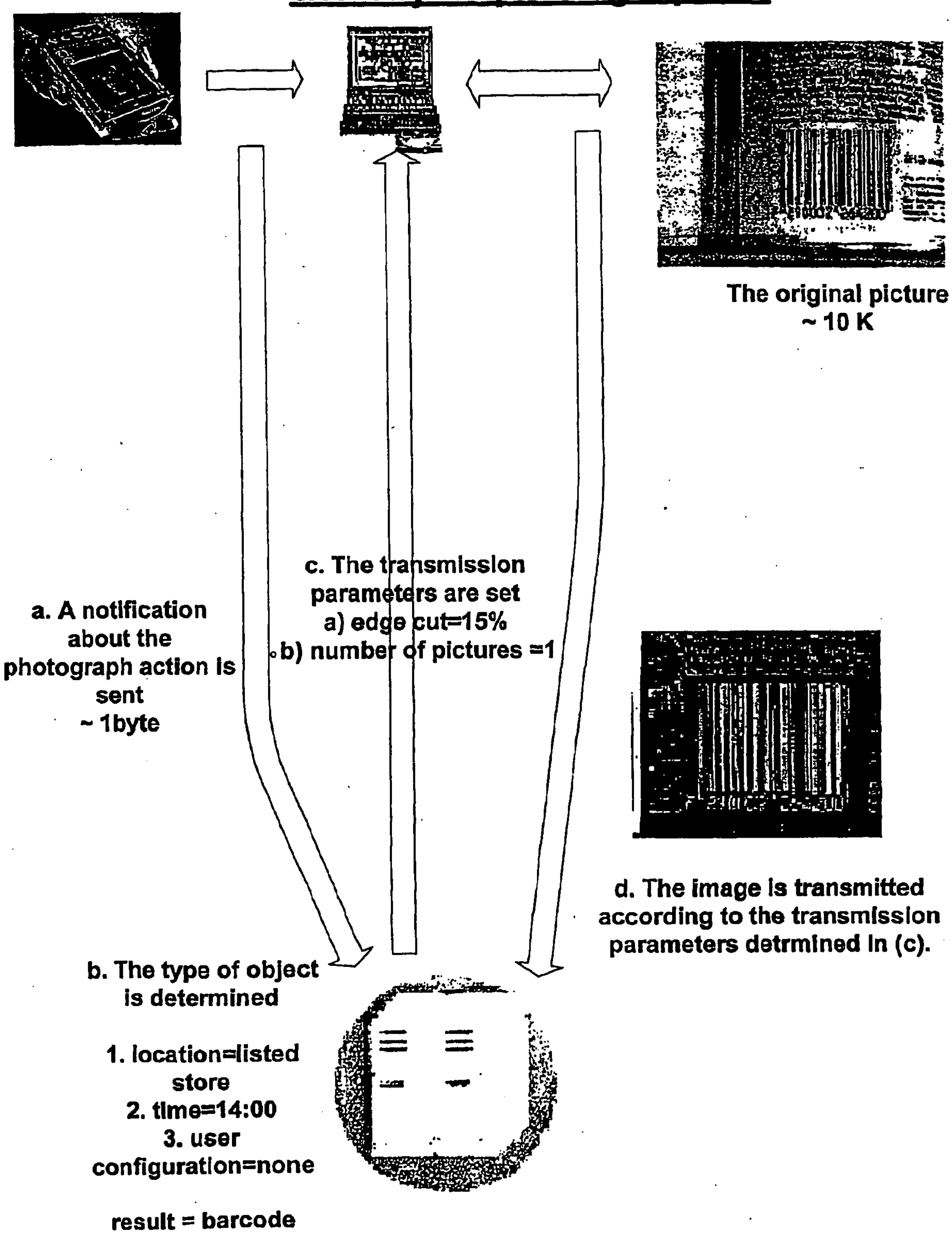


FIG.4: An algorithm for extraction of a headline area from a single picture of a news paper

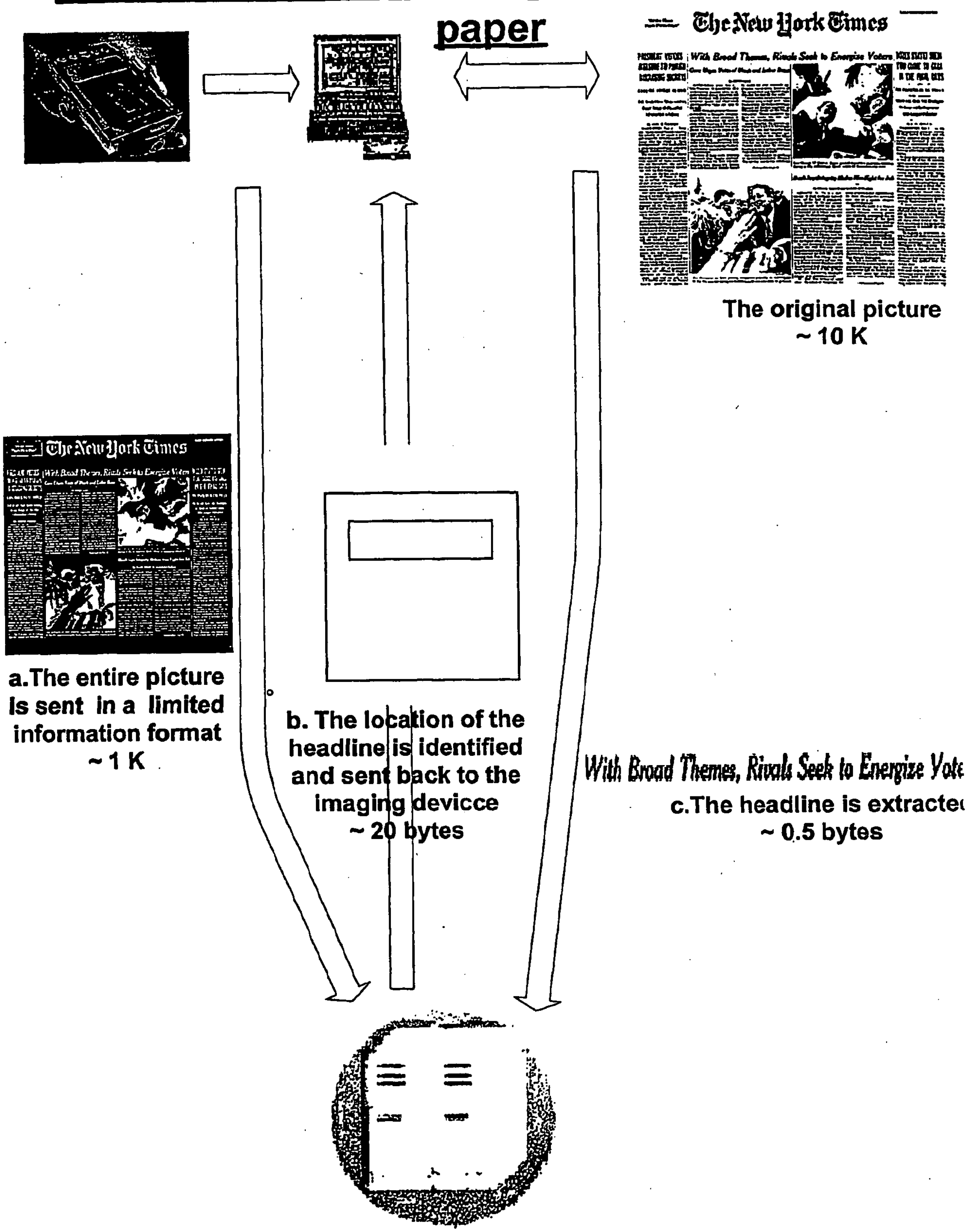


FIG.5 An algorithm for extraction of a barcode's digits area from a single picture of a product

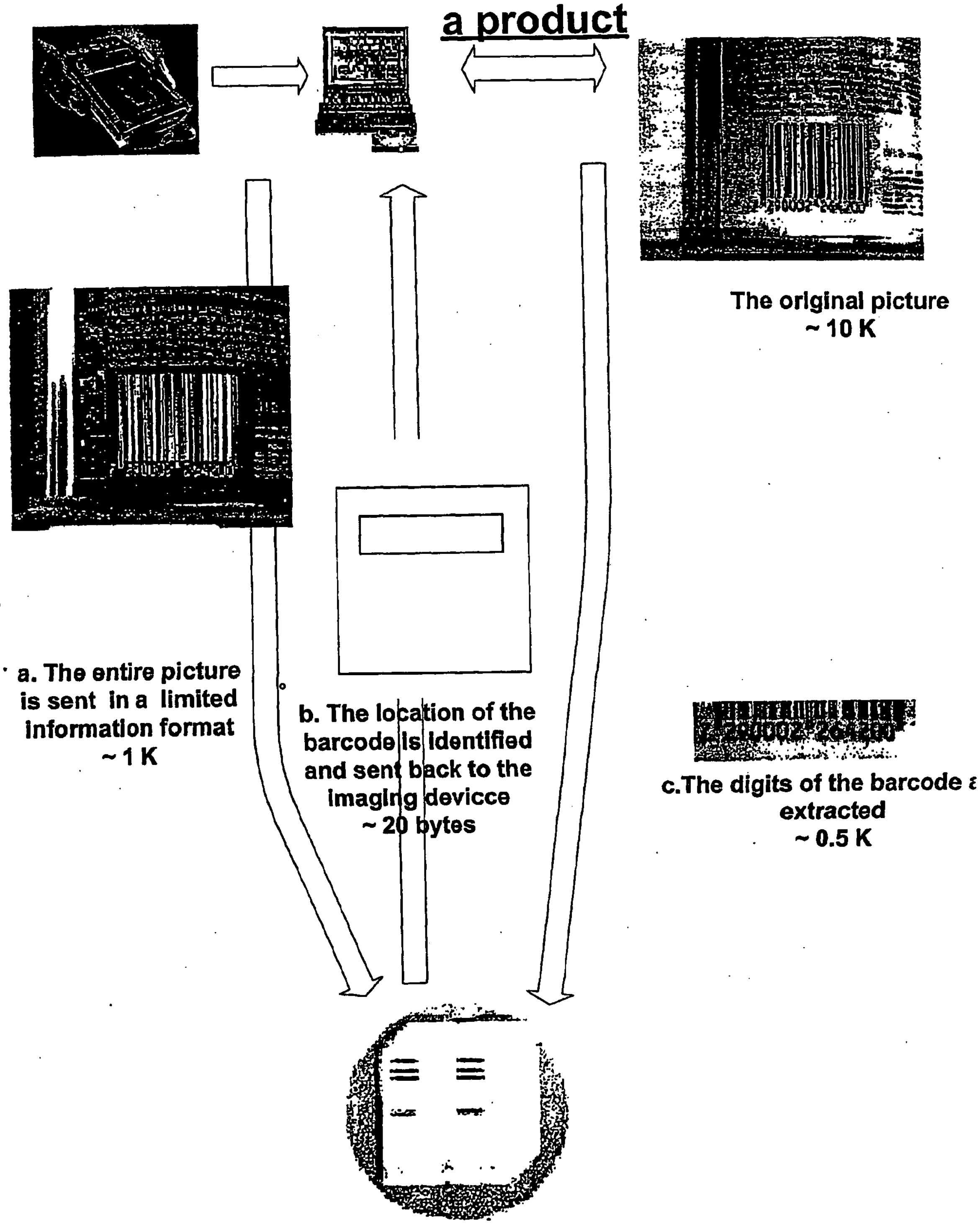


FIG.6: A stitch[illegible]g method using [illegible]lective transmission

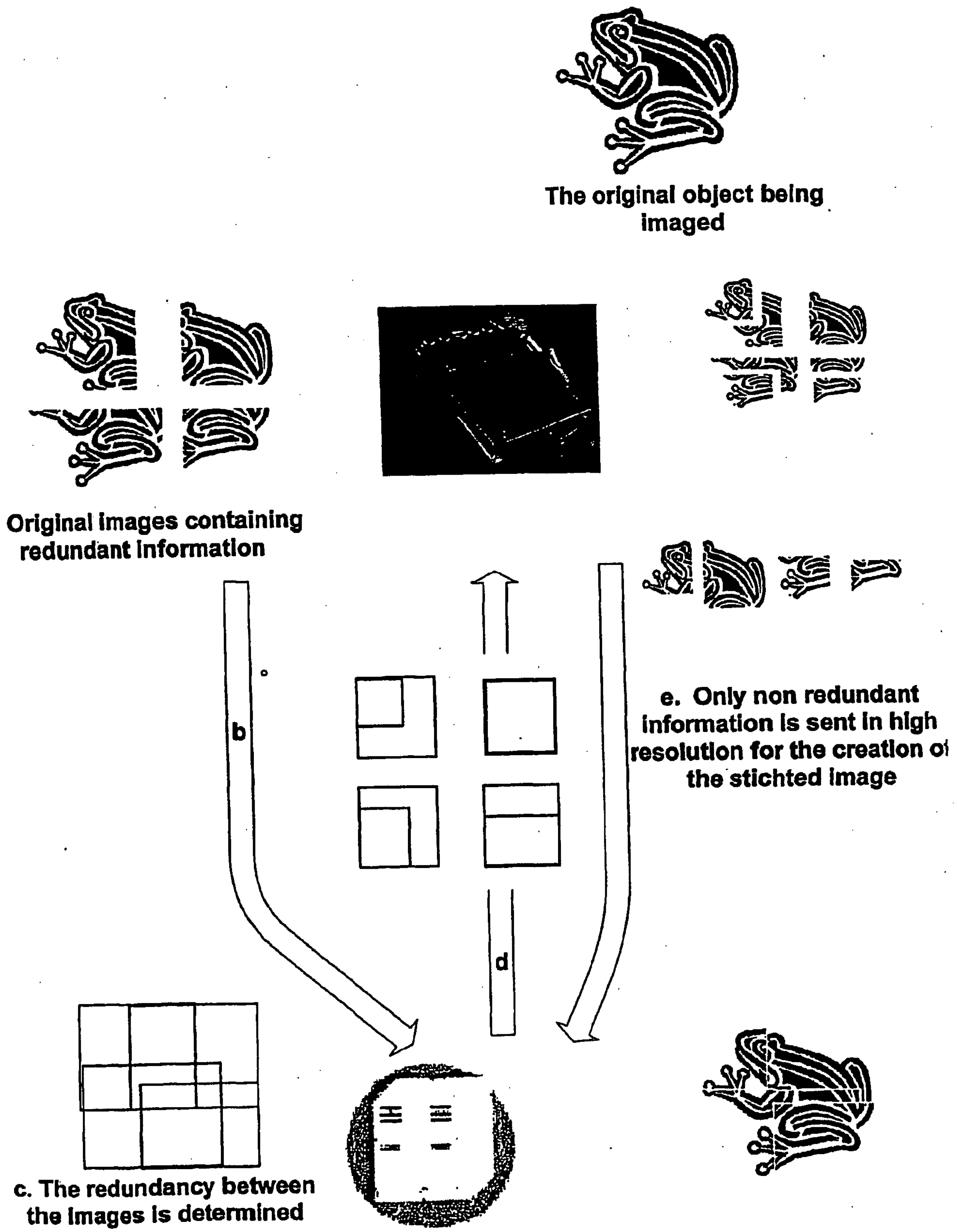
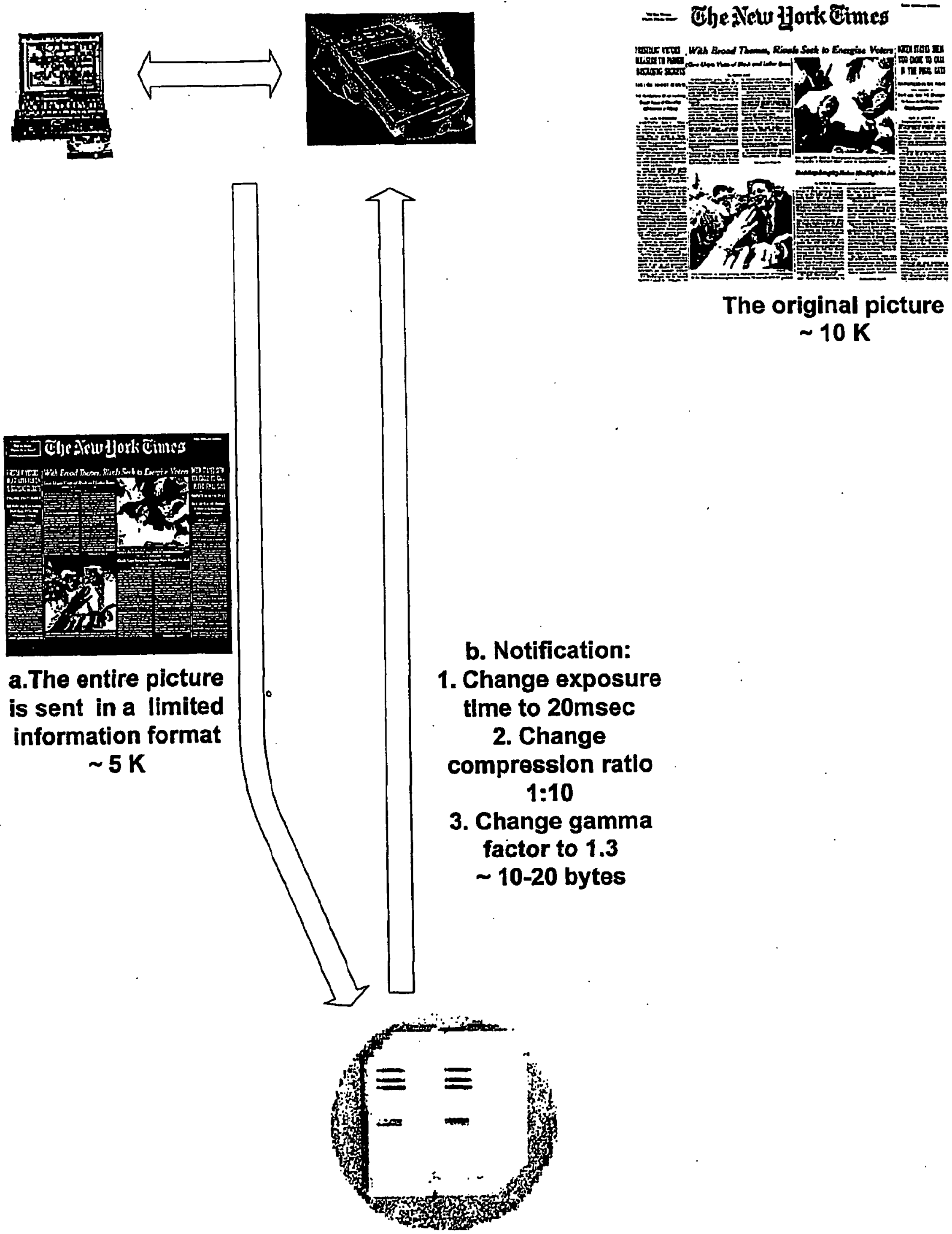


FIG 7. Control of the imaging process



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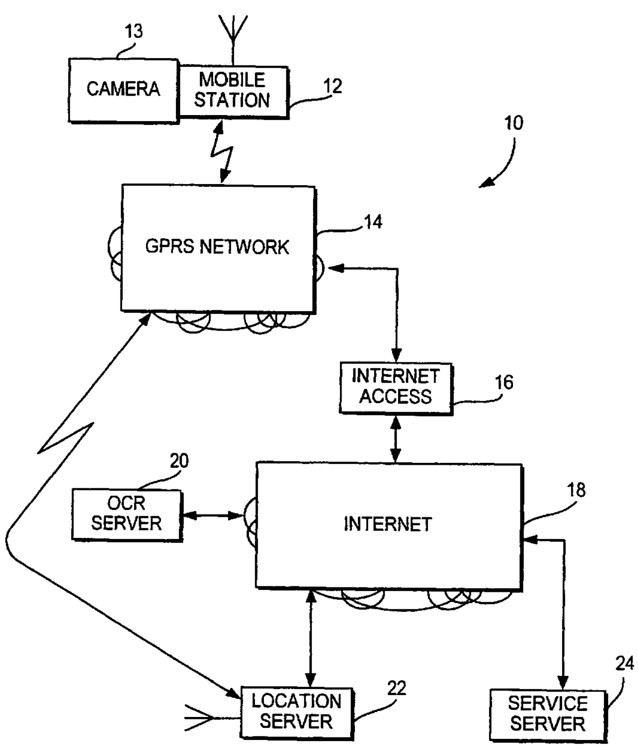
[Continued on next page]

(54) Title: METHOD AND APPARATUS FOR PROVIDING LOCATION INFORMATION THROUGH A WIRELESS COMMUNICATIONS NETWORK



(57) Abstract: A method and apparatus for obtaining information about an object through interaction between a mobile station (MS) and a computer network such as the Internet, and communicating the information to the MS. A digital camera obtains an image of an object, such as a geographic region proximate the MS, which is then transmitted through the mobile communications system to the computer network. A converter server such as an Optical Character Reader (OCR) server interfaced with the global computer network converts the digital image to a text format which is then compared, along with a general location identifier of the MS to geographic data stored in a location database connected to the global computer network. Based on a comparison of the converted text data and the general location identifier of the MS to the geographic data stored in the location server, a precise location of the MS is determined and transmitted to the MS.

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METHOD AND APPARATUS FOR PROVIDING LOCATION INFORMATION THROUGH A WIRELESS COMMUNICATIONS NETWORK

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention provides a method and apparatus for obtaining information using a mobile station (MS) through interaction with a communications network.

2. Description of the Related Art

In mobile communications systems it is often desirable to pinpoint with relative accuracy a geographic location of a mobile station. Such exact location information can be used for numerous purposes such as, for example, to provide directions to a system user of the mobile station who is lost or trying to avoid road congestion, directing the system user to a nearby service provider (e.g. to obtain gasoline, automotive repairs), obtaining information about a location or object proximate the mobile station, etc. Several techniques are known for obtaining a general location of a mobile station. For example, the general location may be determined using Location Service Area (LSA) identification techniques employed in known SoLSA techniques. The LSA is a location service area corresponding to the cell coverage area of a particular mobile network cell through which the MS communicates. Other location determining techniques are discussed in WO-9205672; U.S. Patent No. 5,128,925; WO-9727711; EP 0 930 513 A2 and WO-9819479.

Although such prior art systems are useful in that they may provide for the communication to a MS of information pertaining to a general or large surrounding geographic area encompassing the MS, such known techniques do not identify, with relative pinpoint accuracy, an exact location of a MS. Thus, a user of a MS cannot be informed of pertinent information concerning the immediate geographic area surrounding the MS.

SUMMARY OF THE INVENTION

The present invention improves over prior locator and information systems by providing a method and apparatus for identifying a precise location of a mobile station through interaction with a mobile communications network and a global computer network. This is accomplished, in accordance with one embodiment of the present invention, by inputting to a subject mobile station, a digital image of a geographic location surrounding the subject MS or an object proximate the MS and transmitting the digital image through a mobile communications network, such as a General Packet Radio Service (GPRS) network or a Global System for Mobile Communication (GSM), servicing the MS. The digital image is then conveyed to a global communications network, such as the Internet or World Wide Web, through an access port. A conversion server is accessible through the global communications network for converting the digital image data to text data which is then forwarded to a location server, also accessible through the global communications network. The location server receives a general location address of the MS by, for example, identifying a base station through which the MS communicates and, utilizing the general location address and text data, compares this information to geographic location information stored in a database. The stored geographic location information is typically a library of regional street maps and landmarks contained in a database located in or accessible by the location server. Once the exact location of the MS is determined, the location information is transmitted back to the MS.

The determined location information can be used in numerous applications. For example, in one embodiment one or more service servers can be accessible to the global communications network to provide a host of information services tailored to the determined MS location. Such services may include providing a local street traffic report, a weather report, as well as the identities and locations of the nearest goods or service providers to allow a MS user who may be in need of immediate goods/services to locate such goods/services, e.g., the location of a nearest gasoline station or automotive repair center, etc.

In another embodiment, a digital image of an object or location proximate the MS is obtained and transmitted, through the MS, to a computer network. The computer network, in turn, analyzes the image, obtains information concerning the image and transmits such obtained information to the MS. For example, the object may be a consumer product (e.g., an automobile) and an MS user may desire to obtain information, such as product safety information, concerning the automobile. In accordance with the present invention an image of the automobile can be transmitted by the MS to the computer network to allow the computer network to retrieve desired information relating to the automobile.

Other objects and features of the present invention will become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are designed solely for purposes of illustration and not as a definition of the limits of the invention, for which reference should be made to the appended claims. It should be further understood that the drawings are merely intended to conceptually illustrate the structures and procedures described herein.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, wherein like reference numerals denote similar elements throughout the several views:

FIG. 1 depicts a block diagram of the system architecture of the presently preferred embodiment;

FIG. 2 depicts a block diagram of the system architecture of one alternative embodiment;

FIG. 3 depicts a flow chart of the method in accordance with one embodiment of the present invention; and

FIG. 4 depicts a flow chart of the method in accordance with another embodiment of the present invention

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

A system 10 for providing accurate location information to a mobile communications network user in accordance with a currently preferred embodiment of the present invention is illustrated in FIG. 1. System 10 provides interaction and communication between a mobile station 12 and a computer network 18. The computer network may be, for example, the Internet, or World Wide Web, and these terms are used interchangeably herein. The MS 12 may be a mobile telephone, a personal digital assistant (PDA) as well as any other type of wireless communication devices including a laptop computer with wireless communication capability. The MS 12 communicates with other mobile stations in a manner well-known to those having ordinary skill in the art, through a mobile communications network 14 such as a Global System For Mobile Communication (GSM) or a General Packet Radio Service Network (GPRS). A GPRS network 14 is represented in FIG. 1. Also as is known in the art, network 14 is capable of communicating with the computer network or Internet 18 through wireless transmission to a receiver at an Internet access port 16 for providing a path for information to be exchanged between the MS 12 and the Internet 18. System 10 further includes a data conversion server 20 for converting digital image data to a text format, as is known in the art. A suitable server for this purpose is an Optical Character Recognition (OCR) server. A location server 22 is also accessible through the Internet 18 to obtain specific and precise MS location information in a manner set forth below.

When a user of the MS 12 desires to know his or her exact location, the user will obtain a digital image of a geographic location proximate the MS. Such a digital image may be of a building, an intersection with a street sign, a landmark, etc., and may be obtained through the use of a digital camera 13. In a preferred embodiment, camera 13 may be combined with the MS 12 to form a single component, as more fully described in WO 96-38762, or may be a separate unit capable of being interfaced with the MS 12. In the latter case, camera 113 and mobile station 112 can be interconnected using a fixed transmission line. Alternatively, the digital image can be downloaded to the mobile station 112 from a data storage device, such as a floppy disc onto which the image has been stored. The digital picture obtained by the camera 113 will thus be transferred from the camera to the mobile phone via the fixed transmission line. As an alternative, the digital camera 113 and MS 112 may both include Bluetooth transceivers for providing wireless communication therebetween. Moreover, the digital camera may be mounted to a dashboard of an automobile and electrically or wirelessly connected to an MS such as a car phone. The digital camera could then be controlled by hardware or software contained in the automobile for positioning the camera to obtain an appropriate digital image while the automobile is operated, for example, to receive images of street signs, etc. The MS 12 then communicates the digital image obtained from camera 13 to the mobile network 14 along with a request to identify the exact MS location. Mobile network 14 will contact or otherwise access the Internet 18 through Internet access port 16 and convey the digital image to various servers in communication with the Internet to obtain a precise location of the MS. This is accomplished, for example, by dialing an Internet access code (e.g. telephone number) and connecting to an Internet server.

The apparatus 10 can identify a precise location of the MS by utilizing the digital image information directly or, in accordance with a preferred embodiment of the present invention, convey the digital data to a data converter, such as an Optical Character Recognizer (OCR) server 20 for converting the digital image to binary text data. As is known in the art, the OCR server 20 converts the received digital image of the geographic location proximate the MS 12 into a bit format, e.g. binary text. This information is then communicated to a location server (LS) 22 for identification. Prior to, after or concurrent with the receipt of the binary text version of the geographic image, the LS will obtain a general location in which the geographic image is contained, i.e., in which the MS is located. This is performed through communication between the LS and the communication network 14. For example, in response to a request placed by the LS, the network 14 will provide the LS with the Location Area Identity (LAI) of the cell/base station (BS) or group of cells/base stations in communication with the MS 12 as well as other information the network 14 may have concerning the general location of the MS 12. In the case of a GSM network 14, the LAI can be in the form of a visitor location register (VLR) of a Mobile Switching Center (MSC).

The LS contains or has access to a database containing location information such as street maps, locations of buildings, landmarks, etc. Upon receipt of the LAI which identifies the general geographic region of the MS 12, the LS uses the binary text information to pinpoint an exact location within the general geographic region. This is accomplished by comparing the binary text and LAI information with the location database data. The OCR server has the capability of constructing patterns from images of the transmitted picture. Thus, the patterns will be compared to existing patterns in the location server and mapped to certain database patterns, provided that a certain minimum threshold of mapping is met. Once a location or "match" is identified, the location is transmitted back to the MS. This can occur via a combination of the Internet 18 and network 14, or directly between the LS 22 and network 14 through, for example, wireless communication therebetween. The location information can be in the form of a text message or diagram (e.g. map) displayed on a display incorporated in the MS, or may be an audible message broadcast from a mobile phone or from speakers connected to a mobile phone such as when a location request is placed through a car phone.

The precise location information can be used in a variety of applications and to provide a variety of information services to a MS user. For example, in the event the MS user is lost while driving, the inventive apparatus 10 will allow for directions to be transmitted to the user once the MS precise location is known. In a preferred embodiment, a service server 24 may be provided in communication with, for example, the Internet 18 for conveying information in response to a query placed through the MS concerning goods or service providers that are located closely proximate to or in the immediate vicinity of the MS user. For example, if the user is in need of gasoline or automotive repairs, the precise MS location can be used to access the service server 24 to locate gasoline stations or service stations closely proximate to the MS 12 and to provide directions to such stations. In the event the goods or service providers have a URL address to provide for Internet access, such addresses can also be transmitted for display on the MS. In another embodiment, the service server 24 may be part of or used in conjunction with an incentive rewards program as more fully disclosed in commonly-owned U.S. Patent Application Serial No. ______ *Method and Apparatus for Accessing an Interactive Incentive Rewards Program Through a Wireless Communications Network*, filed November 23, 1999, the disclosure of which is incorporated herein by reference, to provide the location of service provider program members which can then be visited by the MS user to redeem or accumulate rewards points.

As an alternative to the apparatus 10 of FIG. 1 wherein the OCR server 20, location server 22 and service server 24 are capable of direct communication with the

Internet 18, a system 100 can be provided wherein a local area network (LAN) 130 can be used to interface these components with the Internet in a manner well-known to those having skill in the art. Moreover, although separate components are shown, the OCR server, location server and service server can be integral with the LAN 130.

Turning now to FIG. 3, a flow chart of the inventive method of obtaining a precise location for a MS is depicted. The communication of a digital image from the MS to the OCR server is described in steps 3.1 to 3.7. The communication between the location server and the mobile network to obtain the mobile station LAI is described in steps 3.8 and 3.9, and the location server mapping to identify an exact location of the MS and to transmit the location information to the MS is described in steps 3.10 and 3.11. In the event extra services are requested, such as through the inclusion of and communication with a service server 24, steps 3.12 to 3.14 are performed.

In yet another embodiment of the invention shown by the method of FIG. 4, system 10 can provide information concerning a product or object by obtaining a digital image of the product or object and transmitting the image via connection with the MS 12 to the Internet 18. The digital image will then be identified by the service server 24 and, in response to a query or other command communicated to the Internet by a user of the MS12, will locate and provide information pertaining to the image of the object. In this manner, information can be provided, for example, on a consumer product (e.g., automobile) by transmitting a digital image of the automobile along with a query to search and locate desired information such as for safety features, manufacturer cost, etc.

With continued reference to Fig. 4, the invention can be used to provide information on people, such as by obtaining an image of a person's face and transmitting the image to the OCR server. For example, is a user recognizes someone (e.g., a famous person, etc.) but cannot recall the person's name, a picture of the person can be taken and transmitted to the OCR which will, in turn, locate and provide the user with information about the person.

The system 10 can also be used to assist travelers with foreign language translations. For example, a digital image of a sign or word containing foreign language can be conveyed to the service server 24 for translation, with the translation then being transmitted to the MS along with an audible pronunciation of the word and/or product information relating to the translated word and/or a location associated with the word. Moreover, the system can be used to provide advertisement information pertaining to a specific retail or service provider location by transmitting through the MS an image of a retail outlet. The service server will then locate, via access to an advertiser database, information concerning special offers or sales pertaining to the retail outlet, etc. The cost of such information service can be primarily paid by such advertisers, thereby reducing the cost of such service to the MS user.

Thus, while there have shown and described and pointed out fundamental novel features of the invention as applied to a preferred embodiment thereof, it will be understood that various omissions and substitutions and changes in the form and details of the devices illustrated, and in their operation, may be made by those skilled in the art without departing from the spirit of the invention. For example, it is expressly intended that all combinations of those elements and/or method steps which perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. Moreover, it should be recognized that structures and/or elements and/or method steps shown and/or described in connection with any disclosed form or embodiment of the invention may be incorporated in any other disclosed or described or suggested form or embodiment as a general matter of design choice. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.

CLAIMS

What is claimed is:

1. A method of obtaining a geographic location of a mobile station, comprising the steps of:

obtaining a digital image of a geographic location proximate the mobile station;

wirelessly transmitting said digital image from said mobile station to a mobile communications network;

contacting a computer network through said mobile communications network;

obtaining a general location identifier of the mobile station from said mobile communications network; and

comparing the general location identifier and information corresponding to said digital image to pre-stored data accessible through said computer network to determine the geographic location of the mobile station.

2. The method of claim 1, further comprising converting the digital image to a binary text format and wherein said information corresponding to said digital image comprises said binary text format.

3. The method of claim 2, wherein the converting of the image from digital format to binary text format is performed using an optical character reader (OCR) in communication with the computer network.

4. The method of claim 1, wherein said mobile communications network comprises a GSM network and said step of obtaining a general location identifier of the mobile station comprises obtaining a Location Area Identity (LAI) associated with the mobile station.

5. The method of claim 2, wherein said pre-stored data comprises area maps contained within the general location and wherein said comparing step further

comprises comparing the binary text format and general location identifier to the area maps.

6. The method of claim 1, wherein said step of obtaining a digital image further comprises the step of utilizing a digital camera capable of communicating with the mobile station.

7. The method of claim 6, wherein the digital camera is integrally formed with the mobile station.

8. The method of claim 1, wherein the mobile station comprises a mobile telephone and wherein said computer network comprises a global computer network.

9. The method of claim 1, wherein said mobile communications network comprises a General Packet Radio Service (GPRS) network.

10. The method of claim 1, further comprising the step of transmitting the identified geographic location to the mobile station.

11. The method of claim 1, further comprising the step of identifying the location of service providers utilizing the identified geographic location in response to a query transmitted by the mobile communications system to the computer network and transmitting identified service provider location information to the mobile station.

12. The method of claim 11, wherein said service provider location information corresponds to service providers that are participants in a rewards program so that a user of the mobile station who is a member of the rewards program can solicit the service providers to acquire rewards points and to redeem rewards points.

13. An apparatus for obtaining a geographic location of a mobile station comprising:

a digital camera capable of interfacing with the mobile station for obtaining a digital image of a geographic area proximate the mobile station and for conveying the digital image to the mobile station;

a mobile communications network for receiving the digital image from the mobile station, said network having means for determining a general location identifier of the mobile station;

a computer network in communication with said mobile communications network for receiving the digital image and the general location identifier of the mobile station from said mobile communications network;

a location server having access to a library of stored geographic location data; and

means for comparing the text data and general location identifier to the stored geographic location data to identify the geographic location of the mobile station.

14. The apparatus of claim 13, further comprising a converter in communication with said computer network for converting the digital image into text data;

15. The apparatus of claim 13, wherein the mobile station is a mobile phone integrally formed with said digital camera.

16. The apparatus of claim 13, wherein said mobile communications network comprises a General Packet Radio Service (GPRS).

17. The apparatus of claim 13, wherein said global communications network comprises a Global System for Mobile Communication (GSM).

18. The apparatus of claim 17, wherein the general location identifier comprises a Location Area

Identity (LAI) of a base station in communication with the mobile station.

19. The apparatus of claim 13, further comprising a service provider database in communication with said computer network for identifying service provider locations based on the identified geographic location of the mobile station.

20. The apparatus of claim 13, further comprising means for transmitting the identified geographic location to the mobile station.

21. The apparatus of claim 19, further comprising means for transmitting the identified geographic location and the identified service provider locations to the mobile station.

22. The apparatus of claim 21, further comprising means for identifying locations of service providers corresponding to service providers that are participants in a rewards program so that a user of the mobile station who is a member of the rewards program can solicit the service providers to acquire rewards points and to redeem rewards points.

23. The apparatus of claim 13, wherein said digital camera includes means for wirelessly communicating the digital image to the mobile station.

24. A method of obtaining information using a mobile station, comprising the steps of:

obtaining a digital image of an object proximate the mobile station;

wirelessly transmitting said digital image from said mobile station to a mobile communications network;

contacting a computer network through said mobile communications network;

analyzing the transmitted digital image to obtain desired information; and

transmitting the obtained desired information to the mobile station.

25. The method of claim 24, wherein said mobile station is a mobile telephone.

26. The method of claim 24, wherein said computer network is the Internet.

27. The method of claim 24, wherein the object comprises a text symbol and wherein the transmitted obtained information comprises a translation of the text symbol and a pronunciation of the text symbol.

28. The method of claim 24, wherein the transmitted obtained information comprises information relating to the object.

29. The method of claim 24, wherein the object is the face of a person.

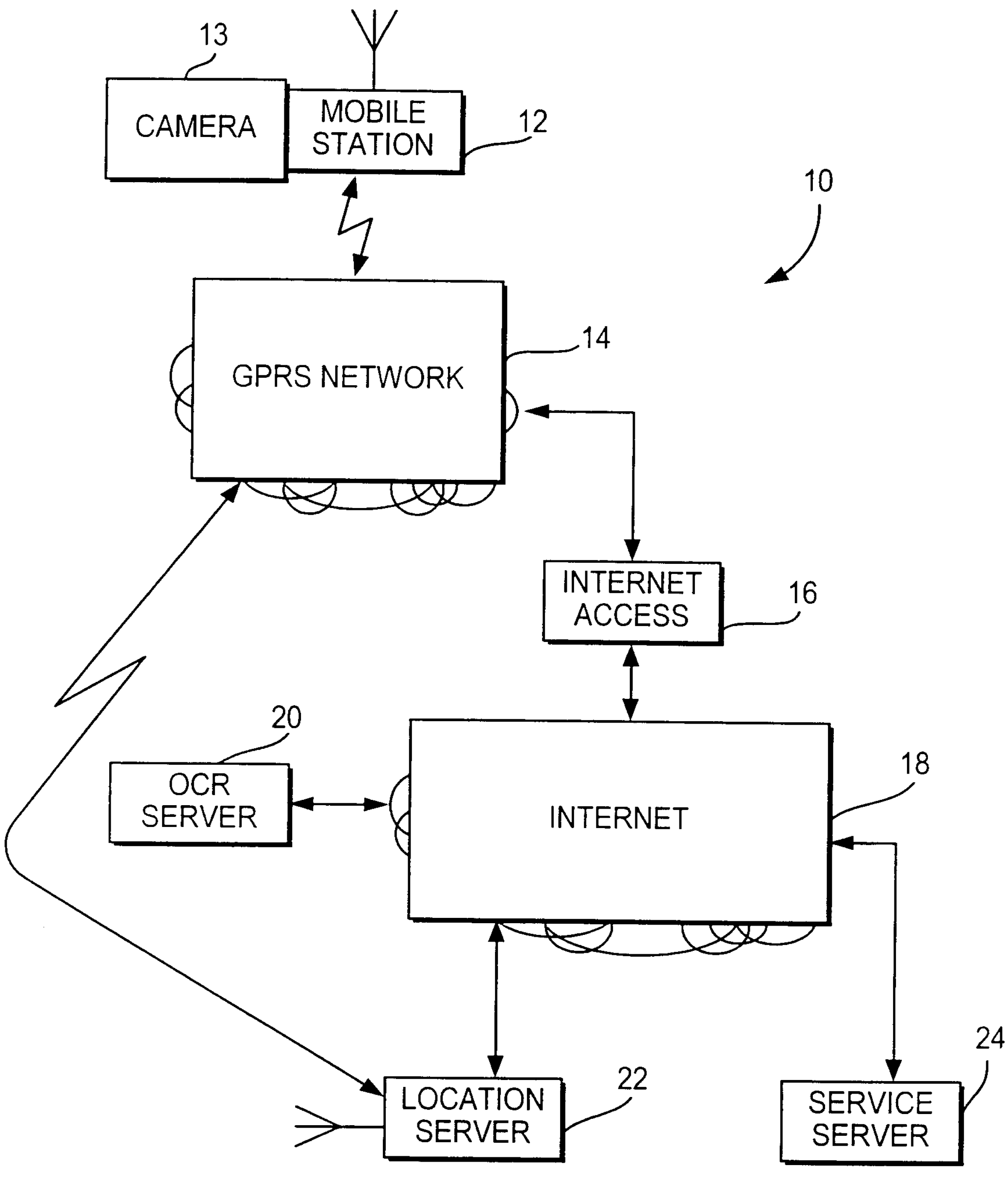
13
CAMERA
MOBILE STATION
12
10
GPRS NETWORK
14
INTERNET ACCESS
16
20
OCR SERVER
INTERNET
18
LOCATION SERVER
22
24
SERVICE SERVER

FIG. 1

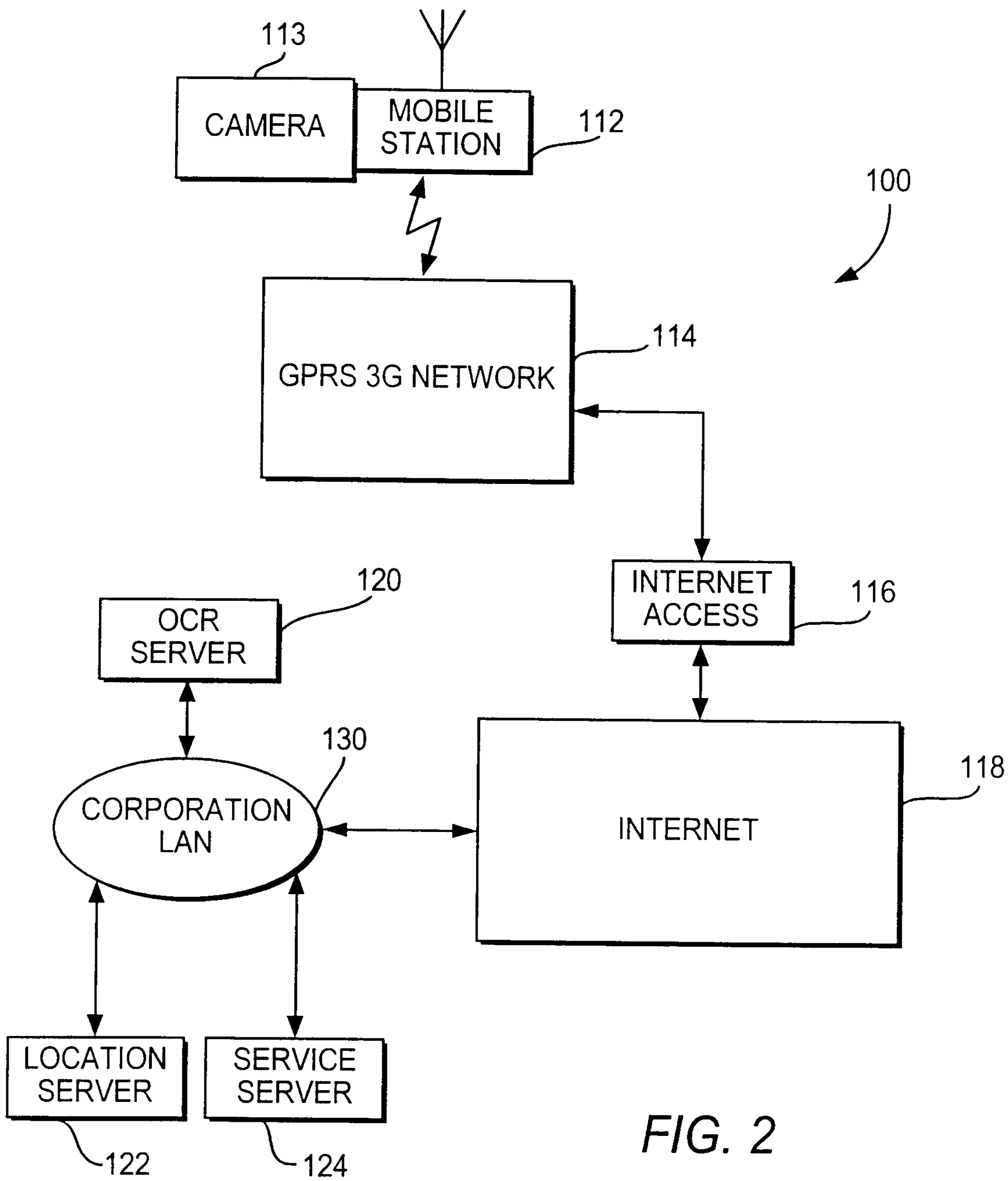
113
CAMERA
MOBILE STATION
112
100
GPRS 3G NETWORK
114
INTERNET ACCESS
116
120
OCR SERVER
130
CORPORATION LAN
INTERNET
118
LOCATION SERVER
SERVICE SERVER
122
124

FIG. 2

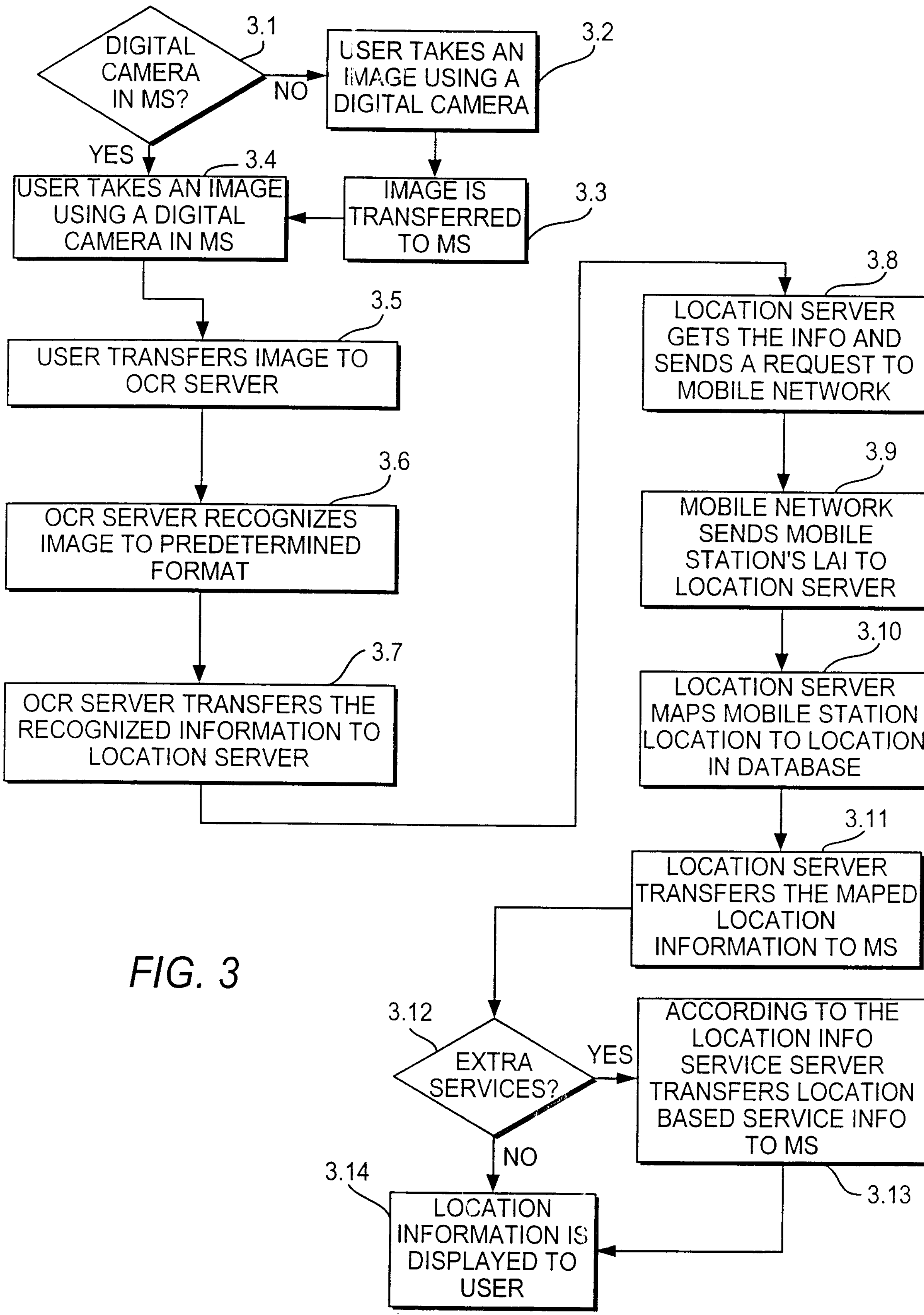
DIGITAL CAMERA IN MS?
3.1
NO
YES
USER TAKES AN IMAGE USING A DIGITAL CAMERA
3.2
IMAGE IS TRANSFERRED TO MS
3.3
USER TAKES AN IMAGE USING A DIGITAL CAMERA IN MS
3.4
USER TRANSFERS IMAGE TO OCR SERVER
3.5
OCR SERVER RECOGNIZES IMAGE TO PREDETERMINED FORMAT
3.6
OCR SERVER TRANSFERS THE RECOGNIZED INFORMATION TO LOCATION SERVER
3.7
LOCATION SERVER GETS THE INFO AND SENDS A REQUEST TO MOBILE NETWORK
3.8
MOBILE NETWORK SENDS MOBILE STATION'S LAI TO LOCATION SERVER
3.9
LOCATION SERVER MAPS MOBILE STATION LOCATION TO LOCATION IN DATABASE
3.10
LOCATION SERVER TRANSFERS THE MAPED LOCATION INFORMATION TO MS
3.11
EXTRA SERVICES?
3.12
YES
NO
ACCORDING TO THE LOCATION INFO SERVICE SERVER TRANSFERS LOCATION BASED SERVICE INFO TO MS
3.13
LOCATION INFORMATION IS DISPLAYED TO USER
3.14

FIG. 3

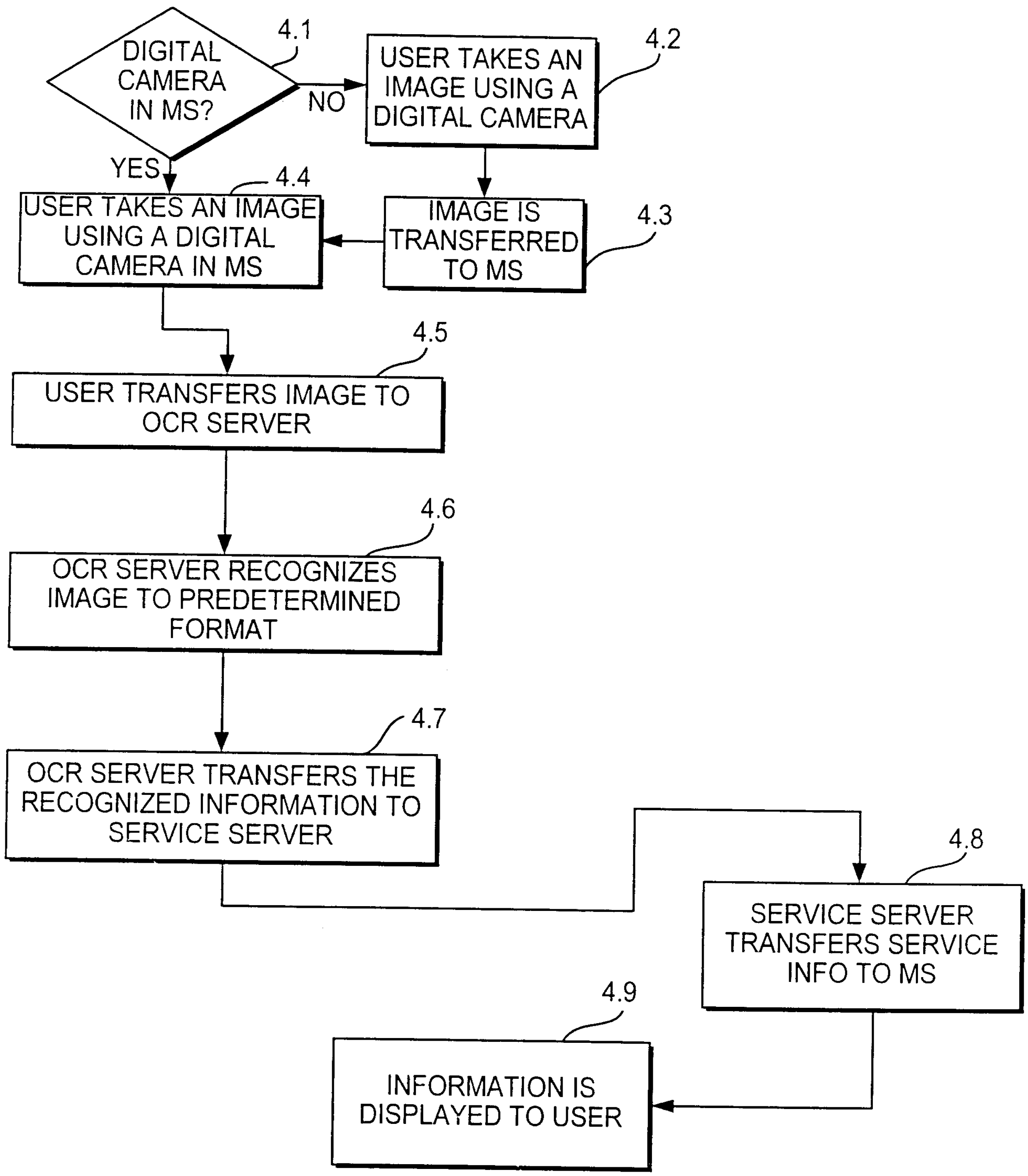
4.1
DIGITAL CAMERA IN MS?
NO
YES
4.2
USER TAKES AN IMAGE USING A DIGITAL CAMERA
4.3
IMAGE IS TRANSFERRED TO MS
4.4
USER TAKES AN IMAGE USING A DIGITAL CAMERA IN MS
4.5
USER TRANSFERS IMAGE TO OCR SERVER
4.6
OCR SERVER RECOGNIZES IMAGE TO PREDETERMINED FORMAT
4.7
OCR SERVER TRANSFERS THE RECOGNIZED INFORMATION TO SERVICE SERVER
4.8
SERVICE SERVER TRANSFERS SERVICE INFO TO MS
4.9
INFORMATION IS DISPLAYED TO USER

FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB 00/01933

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01S H04Q G03B G08G G08B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 705 046 A (US WEST TECHNOLOGIES INC) 3 April 1996 (1996-04-03) page 13, line 3 - line 28 page 19, line 50 - line 57 ---	1,13
A	EP 0 869 464 A (NEDAP NV) 7 October 1998 (1998-10-07) column 2, line 43 - line 58 column 4, line 43 - line 58 ---	1,13
A	EP 0 785 535 A (MITSUBISHI ELECTRIC CORP) 23 July 1997 (1997-07-23) column 4, line 15 - line 40 -----	1,13

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
10 May 2001	25/05/2001

Name and mailing address of the ISA	Authorized officer
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4

INTERNATIONAL SEARCH REPORT

.ormation on patent family members

Interr nal Application No

PCT/IB 00/01933

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
EP 0705046	A	03-04-1996	US	5570412 A	29-10-1996
			JP	8182035 A	12-07-1996
EP 0869464	A	07-10-1998	NL	1005730 C	07-10-1998
EP 0785535	A	23-07-1997	CA	2189515 A	17-07-1997
			JP	9257501 A	03-10-1997

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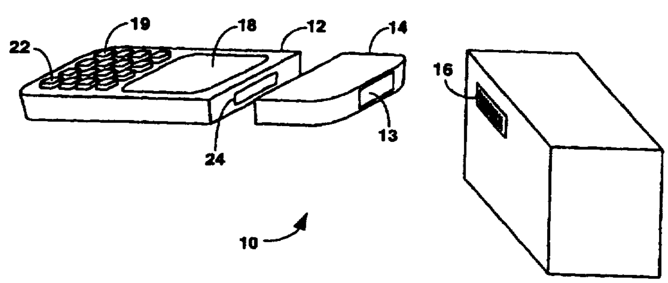

(57) Abstract

A coded image capture and decoding system (10) includes an image capture (14) unit and a host unit (12) which operate to capture image data, generate a plurality of coded images, and, thereafter, to decode the plurality of coded images with a non-dedicated host processing circuitry. The system comprises an image capture unit (14) and a host unit (12) which may be installed together or separately in one or more physical devices. The image capture unit (14) includes an image processor, an image buffer, an optical unit, an image buffer and an interface module. The host unit (12) includes a host processor, conventional hardware and software functions, and an interface module. During a capture cycle, the image capture unit (14) repeatedly captures images from a coded target (16). When the capture cycle is complete, the image capture unit (14) attempts to interrupt the host unit (12). The host unit (12) responds to the interrupt when it is available, receives the plurality of coded images over a communication link, and performs decode processing of the coded images.

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TOO LONG CODE READER PERFORMING CODED IMAGE DECODING

Background Of The Invention

1. Technical Field of the Invention

This invention relates generally to coded image capture and decoding, and, more particularly, to a coded image capture and decoding system having capture processing circuitry for capturing a plurality of images, and having host processing circuitry which manages, among many other processing tasks, the decoding of the images. The capture processing circuitry operates to prevent the host processing circuitry from having to dedicate itself in real-time to the decode processing of incoming captured coded images from the capture processing circuitry, permitting the host processing circuitry to be shared by other hardware and/or software for performing other often real-time tasks. In addition, the capture processing circuitry functionality also permits both the host and capture processing circuitry to achieve enhanced power conservation performance.

2. Description of Related Art

As is well known, optical targets, such as a bar code label, can be found on goods or articles for tracking or accounting purposes, for example. Each of the optical targets contain coded information which either directly provides information about the good or article marked with the optical target, or indirectly provides such information with the assistance of cross-reference databases. For example, the target may only contain an alphanumeric sequence that a cross-referenced database uses to identify details regarding the good or article marked with the target such as the type of good, destination, cost, manufacturer, etc.

Conventional coded image capture and decoding systems sequentially capture images of coded optical targets, and attempt to decode each image as it is captured. If a first image is successfully decoded, the capturing process ends. Otherwise, another image is captured for a further decode attempt. Typically, this sequence continues until either a coded image is successfully decoded, or a predefined number of failed decode attempts occurs. Upon successfully decoding a coded image, the decoded data is often compared to a cross-reference database to extract further information. Such information and the decoded data are then used for specific applications such as retail checkout, package identification, tracking, shipping and accounting.

Coded targets may comprise one or two-dimensional images. A bar code label constitutes an exemplary one-dimensional coded target. Bar codes provide a robust mechanism for encoding and decoding relatively small amounts of data. Although two-dimensional coded targets typically incorporate more data than one-dimensional targets, they often prove much more difficult to decode.

Some coded image capture and decoding systems comprise both a hand-held unit and a stationary host unit. Such a configuration can be found, for example, in point-of-sale applications wherein a wand reader or low-cost, hand-held bar code reader captures and communicates coded images to a cash register host via a wired or wireless link to perform decode and subsequent processing.

In such systems, the hand-held capture unit includes optical components for assisting in the capture of coded images. For example, the optical components in a typical wand comprises a laser diode and a phototransistor detector. In a laser scanning reader, the optical assembly might also comprise scanning motors, mirrors and lens assemblies. Similarly, for continuous or flash type readers, the optical components might comprise photodetector arrays, lens systems, mirrors and flash or LED (light emitting diode) light sources. In addition, the hand-held capture units of such systems typically contain image processing and interface circuitry for communicating each coded image to the stationary host unit for attempts at decode processing.

Other coded image capture and decoding systems comprise battery powered portable units and include both coded image capture and decode functionality. In addition to performing capture and decode functionality, such portable units often perform tracking, inventory, data processing, communication functions, etc. Typically, the portable units require a high performance host processor that performs the image decoding functions as well as other hardware and software functions. The high performance host processor, as well as the associated support circuitry, consumes significant power during its operation and quickly drains the battery powering a portable unit. Some portable units that capture and decode two-dimensional codes also require high power consuming digital signal processors for decoding functions, causing the units to have limited battery life.

In operation of such systems, a read cycle is typically initiated by pushing a button, pulling a trigger or through proximity detection of a coded image within reading range. Upon initiation of a read cycle, the system delivers light, such as a scanned laser beam, LED or xenon flash, for example, to a coded target. A photodetector means of the system receives reflections from the coded target, capturing the reflected image (hereinafter a "coded image"). Interface circuitry delivers the coded image from the photodetector to a waiting host processor. Typical photodetector means include a single or plural phototransistors or phototransistor (CCD) arrays, for example.

The capturing of a coded image often occurs at a relatively slow rate in relation to typical host processor execution times. For example, laser type scanning systems scan a laser beam across a coded target at relatively slow scan rate to provide sufficient exposure time for photodetector sensing. Optical units that include an array of photosensitive elements typically require relatively long exposure times, and slowly produce image data sequentially after a target is read. Optical units also often include lenses that must be adjusted to focus on the target to capture valid image. Lens adjustments also occur relatively slowly. Because coded images are produced no faster than the rate the image data is received, coded images are typically transmitted to the host processor at a much slower rate than the fastest decode rate achievable by the host processor.

Thus, the host processor in conventional systems remains in a dedicated mode waiting for then attempting to decode each image as it is captured until one of the images is successfully decoded. During this time, the host processor is not able to conduct other types of processing or enter a worthwhile power saving state. Because some other types of processing often require real time dedication as well, additional dedicated processors or processing circuitry often proves necessary even though cost and power consumption increase.

Thus there is a need in the art for a reduced power, coded image capture and decoding system that solves the foregoing and other problems that will become apparent in view of the drawings and remainder of the specification which follows.

SUMMARY OF THE INVENTION

Along with many other advantages and benefits, in order to overcome at least many of the limitations of the prior art systems, a coded image capture and decoding system of the present invention captures image data upon initiation of a capture cycle, generates coded images, buffers the coded images, and decodes the coded images in a non-dedicated processing fashion when decode processing capability is available.

The system of the present invention includes an image capture unit, a host unit, and a communication link between the two. The image capture unit includes an image processor, an optical unit, an image buffer, and an interface module. The host unit includes a host processor, conventional hardware and software functions, and an interface module capable of communication with the interface module of the image capture unit. The image capture unit may physically connect to the host unit or may be separate and communicate in a wireless fashion.

In operation, upon initiation of a capture cycle the optical unit optically reads a target to produce image data. The image processor receives the image data and produces coded images. The image processor writes the coded images to the image buffer until the capture cycle is complete. Once the capture cycle is complete, the image capture unit interrupts the host unit to receive the coded images. When ready, the host unit receives the coded images from the image capture unit and decodes the coded images.

In this fashion, the coded image capture and decode system of the present invention does not require dedicated operation of the host processor thereby reducing power consumption and allowing the host processor to perform its other required functions.

Further, by separating the coded image capture function from the decoding function, a lower cost processor may be used in the image capture unit thus reducing cost and power consumption. Because the processing capability exists in the host unit, no functionality is lost.

In some configurations, images are only captured when a target is proximate to the optical unit. Images are transmitted to the host unit only when the image processor determines that the image probably constitutes a coded image. The capture cycle may be shortened if code image criteria is satisfied by the coded images already captured during the capture cycle. Similarly, the capture cycle may be extended if no code is detected in the coded images captured during the capture cycle.

A reference code image may be buffered and only code image differences are buffered thereafter to reduce storage and transmission demands. To further reduce storage requirements, signal transition data is identified and buffered.

Further aspects of the present invention will become apparent with reference to the detailed description, drawings and claims.

Brief Description of the Drawings

FIG. 1A is a perspective view illustrating an embodiment of a coded image capture and decoding system of the present invention having a modular assembly.

FIG. 1B is a perspective view illustrating an alternate embodiment of a coded image capture and decoding system of the present invention utilizing a one-piece tablet-sized housing.

FIG. 1C is a perspective view illustrating a further embodiment of a coded image capture and decoding system of the present invention utilizing a tablet-based host computer and a tethered capture unit.

FIG. 1D is a perspective view illustrating another embodiment of a coded image capture and decoding system of the present invention having a wireless communication link between a tablet-based computer and an image capture unit.

FIG. 1E is a perspective view illustrating a network embodiment of a coded image capture and decoding system of the present invention utilizing a plurality of portable capture units.

FIG. 1F is a perspective view illustrating another network embodiment of a coded image capture and decoding system of the present invention.

FIG. 2A is a schematic block diagram illustrating the functional operation of the coded image capture and decoding systems of FIGS. 1A-F.

FIG. 2B is a schematic block diagram illustrating a laser scanning embodiment of the coded image capture and decoding systems of FIGS. 1A-F.

FIG. 3 is a block diagram illustrating several of the various possible design variations which might be made to the coded image capture and processing system of the present invention.

FIG. 4 is a flow diagram which illustrates the basic functionality of the image capture units of FIGs. 1A-F.

FIGs. 5A-C are flow diagrams that illustrating three of the various ways in which the capture unit can be configured to perform the process identified in FIG. 4 of capturing and storing images.

FIGs. 6A and 6B are flow diagrams representing another embodiment of the present invention that illustrate the operation of an image capture unit.

FIGs. 7A and 7B illustrate an alternative method or flow of operation of the systems of the present invention.

FIG. 8 is a flow diagram that illustrates another embodiment of the functionality an image processor of the image capture unit in processing captured image data.

FIG. 9 is a flow diagram illustrating the detailed operation of a host processor in one embodiment of the present invention employing interrupt masking techniques to isolate itself from the image capture unit when other tasks prove more important.

FIG. 10 is a flow diagram illustrating an alternate embodiment where the host processor attempts to construct and decode a composite image only after attempting to decode each of the images retrieved from the image capture unit. A host processor first retrieves all of the transition information stored by the image capture device during a capture cycle.

FIG. 11 illustrates a further embodiment of the operation of a host processor in decoding images retrieved from an image capture unit, wherein an attempt at parallel decode processing is only attempted after an attempt to decode a composite signal fails.

FIG. 12 is a flow diagram illustrating another method for constructing a composite signal by averaging all images retrieved from the image capture unit before attempting to decode.

DETAILED DESCRIPTION OF THE DRAWINGS

FIG. 1A illustrates a coded image capture and decoding system 10 in accordance with the present invention employed to capture and decode coded images using a two piece configuration. The coded image capture and decoding system 10 comprises a host unit 12, an image capture unit 14, and a communication link between the host unit 12 and the image capture unit 14. In a typical configuration, the host unit 12 includes processing, memory storage, interface and, possibly, wireless communication capabilities. The host unit 14 includes a display 18, a keypad interface 19, and additional components that, in addition to serving coded image reading, serve a variety of functions found in conventional hand-held computing devices. The display 18 delivers information to a user while the keypad interface 19 may be employed by a user to communicate with the host unit 12. The host unit 12 also includes an audio interface such as a speaker that relays information to the user in an audible form. The host unit 12 and image capture unit 14 are battery powered, yet may be powered by other sources as well. In addition, the host unit includes an input means such as an enable button 22 that allows a user to initiate the reading of coded targets.

The image capture unit 14 comprises image processing circuitry, an interval timer, an optical unit, an image buffer and an interface module (not shown). The image capture unit 14 can be separated from the host unit 12 to permit the host unit 12 to operate independently. The image capture unit 14 directly attaches to the host unit 12 via a connector 24. When attached, the coded image capture and decoding system 10 constitutes a single, hand-held assembly having all conventional functionality of the independent host unit 12 plus full code reading capabilities.

The image capture unit 14 captures reflected images from the target 16, applies proximity screening, stores the images and attempts to deliver the images to the host unit 12 for decode processing. While the image capture unit 14 performs such functionality, the host unit 12 may either operate on other tasks unrelated to the code reading process or wait in an idle, sleep or other low power state. Only when it is ready to perform decode processing will the host unit 12 turn its attention to the images stored in the image capture unit 14.

In particular, upon capturing a predefined number of reflected images, the image capture unit 14 stops capturing images, delivers a decode processing request to the host unit 12, starts an interval timer to approximately 0.5 seconds and enters a low power state. The host unit 12 may immediately respond to the signal else respond when other ongoing real time tasks so permit. For example, the host unit 12 may be in the middle of a wireless transmission that requires real-time servicing, and, therefore, the host unit 12 completes such servicing before responding to the image capture unit 14. When the host unit 12 does respond, the image capture unit 14 delivers the number of captured images for decode processing.

In one embodiment, the host unit 12 first constructs a composite image from the plurality of images retrieved. If decoding of the composite fails, the host unit 12 attempts to decode all of the images in parallel. In an alternate embodiment, the host unit 12 sequentially attempts to decode each image before resorting to composite image decode processing. Other combinations and ordering of sequential, parallel and composite processing may be implemented, to enhance decode processing performance, as will be described in more detail below.

If the host unit 12 achieves a successful decode, the host unit 12 delivers an indication to the user via the display 18 and a speaker (not shown). If the host unit 12 fails to achieve a successful decode from one set of captured images, the host unit 12 redirects its attention to other matters or reenters a low-power state. When the interval timer times out, the image capture unit 14 begins capturing another set of images for decode processing to repeat the cycle. This cycle repeats until the enable button 22 is released, permitting target after target to be captured and decoded. In another mode, the cycle repeats until the host unit 12 reaches a successful decode. Thereafter, the enable button 22 must be retriggered to read another target.

The time constraints of the decode processing functionality of the host unit 12 are independent of the time constraints associated with the image capture functionality of the image capture unit 14. For example, if the image capture process takes a relatively long period of time in comparison to decode processing, the host unit 12 need not dedicate itself to manage image capture or to perform decode processing on a real-time image by image basis as each image is captured. Similarly, when the image capture process takes a relatively short period of time in comparison to decode processing, the image capture unit 14 need not waste energy continuing to illuminate and capture images that may never be processed. Moreover, with multiple coded images available at a time, the host unit 12 is able to perform decode processing faster, more accurately and without the time constraints imposed on conventional decode processors of having to complete a decode attempt on one image before the next is captured.

The coded target 16 comprises a one-dimensional coded (e.g., a bar code) label. However, in other embodiments, the coded target might comprise a two-dimensional coded label. In either case, the optical unit 14 captures a plurality of reflected images from the coded target 16, buffers such images and attempts to contact the host unit 12 for decoding. The optical unit may include fixed or moveable lenses to focus the optical unit on the target 16. Reflections from the target 16 may be from illumination originating from the optical unit (in the form of a scanned laser beam, xenon flash or LED emission, for example) or may originate from ambient light.

Instead of capturing a series of non-code images and sending them to the host unit 12 to perform futile decode processing, the image capture unit 14 utilizes proximity screening to ensure that a decode attempt of a set of coded images is likely. Proximity screening involves not only the detection of any proximate object, but also involves an evaluation of the proximate object's image to determine whether the object is most likely a coded target. Although proximity screening may be turned off, such screening assists in preventing the image capture unit 14 from bothering the host unit 12 with captured non-code images. Proximity screening is carried out through an examination of, among other characteristics, the number of transitions in any given captured image. Proximity screening might alternately (or additionally) be implemented through evaluation of the magnitude of received reflections, for example.

FIG. 1B illustrates another embodiment of a coded image capture and decoding system 20 of the present invention. In the system 20, the image capture unit and the host unit are contained in a single housing 22. A touch or pen sensitive pad and display 24 receives input from a user to initiate a read cycle or to perform other functions of the host unit. Through an optical window 26, a capture unit (not shown) supports the capture of images of a coded target 28. The coded target 28 constitutes a two-dimensional code which the image capture and host units within the housing 22 are capable of reading. The associated optical unit might comprise a two-dimensional raster scanning laser system that utilizes a single photodetector for capturing reflected images over time in a line by line fashion, or, for example, could comprise a flash system using an array of photodetectors capable of capturing reflections from the entire two-dimensional coded target 28 at one time. Many other types of optical units (or "optical systems") and detecting systems may be employed.

As described previously, using proximity screening, the image capture unit of the system 20 captures and buffers a set of reflected images from the target 28. Once the images are buffered, the image capture unit sends a decode processing request to the host unit, both units being internally contained within the housing of the system 20. When the host unit decides to do so, the host unit retrieves the buffered images and performs decode processing. This process repeats until decoding proves successful.

FIG. 1C illustrates another embodiment of a coded image capture and decoding system 30 of the present invention. In the system 30, the image capture unit 32 and the host unit 34 are contained in separate housings and connected by a multi-conductor cable 36. The multi-conductor cable 36 provides data transfer and control capability between the image capture unit 32 and the host unit 34. Although a battery contained in the host unit 34 powers both the host unit 34 and the image capture unit 32, the units 32 and 34 might be separately powered or a single battery might be located in the unit 32 to power the units.

The image capture unit 32 is a laser scanning hand-held unit for reading bar codes such as a bar code 38. When a user actuates a trigger 33, the image capture unit 32 begins capturing a predetermined number of reflected images, applying proximity screening rules to each image and buffering those that meet such rules. When a predetermined number of images have been captured, screened and buffered, the image capture unit 32 delivers an interrupt to the host unit 34 to indicate the need for decode processing. The host unit 34 may have masked the interrupt while performing other tasks requiring dedicated attention. If masking has not occurred or when the host unit 34 removes the mask, the host unit 34 identifies the interrupt and responds by retrieving and attempting to decode the buffered coded images. If a successful decode is accomplished, the host unit 34 emits an audible sound to notify the user that a capture and decode has occurred. At this point, the user may redirect the capture unit 32 to another coded target.

FIG. 1D illustrates another embodiment of a coded image capture and decoding system 40 of the present invention. In the system 40, the image capture unit 42 and the host unit 44 are contained in separate housings and connected by a wireless link. The image capture unit 42 includes an antenna 46 and the host unit 44 also includes an antenna 48. Thus, the image capture unit 42 and the host unit 44 may be located remote from one another. Because the host unit 44 is located remote from the image capture unit 42, the host unit 44 could either be powered from a wall socket or by battery, and the image capture unit is battery powered.

The image capture unit 42 may be used to capture images of a bar code on a target 49, buffer the captured images, and transmit the coded images to the host unit 44 over the wireless channel for decoding. Although buffering the captured images could exist with the host unit 44, such buffering (at least initially) takes place within the capture unit 42. Thus, instead of requiring the transceiver circuitry to send each image as it is captured, the plurality of buffered images can be delivered whenever the host unit 44 is prepared to engage in decode processing. This proves especially beneficial when: 1) the host unit 44 is out of range; 2) the wireless communication channel is experiencing heavy loading and/or heavy noise; and 3) the host unit 44 is using the channel to communicate with other wireless devices. In such instances, the capture unit 42 need only contend for the channel when the predetermined number of images are buffered and ready for transmission, and communicate the plurality of images when the host unit 44 is available.

FIG. 1E illustrates another embodiment of a coded image capture and decoding system 50 of the present invention. The system 30 comprises a wireless first image capture unit 52, a wireless second image capture unit 54, a wireless combination image capture/host unit 56, a wireless access server 58 and a network 59. The first image capture unit 52 and the second image capture unit 54 each perform only image capture functions while the combination image capture/host unit 56 performs both image capture and decode functions. The wireless access server 58 includes an antenna 53 that allows wireless communication with the first and second image capture units 52 and 54 and the combined unit 56. The wireless access server 58 supports communication between the units 52, 54 and 56 and with remote processing systems and databases (not shown) on the network 59.

The wireless access server 58 includes decode processing functionality to support the units 52 and 54. Such decoding functionality might alternately (or also) be located on the network 59, for example, on a higher power computing system. Alternatively, the image capture units 52 and 54 could communicate buffered images through the wireless access server 58 to the combination capture/decoding unit 56 for decode processing.

In particular, the image capture units 52 and 54 independently begin capturing reflected images then attempt to wirelessly signal the wireless access server 58 when a predetermined number of coded images have been buffered. In response, when the wireless access server 58 is ready, the wireless access server 58 retrieves the buffered images and begins the decoding process. If the decode process proves successful, the wireless access server 58 delivers a success message, along with related data if needed, to the capture unit which sent the images. The capture unit responds by providing an indication of success to the user. If the decode process fails, the capture unit repeats the process.

FIG. 1F illustrates another embodiment of a coded image capture and decoding system 60 of the present invention. The system 60 comprises a wireless image capture unit 62, a cash register 64, a data storage and processing unit 68 and a network 66. The image capture unit 62 performs image capture functions and communicates with the cash register 64 wirelessly. Of course, the unit 62 might alternatively be hard-wired to the register 64. In either case, the cash register 64 serves as the host unit 64 and performs the decode functionality. In executing the decode functionality, the cash register 64 may access the data storage and processing unit 68 over the network 66 to retrieve supplemental decode data. Alternately, the cash register 64 might deliver all image information through the network 66 to the unit 68 for decode processing if the unit 68 is so configured.

Because the cash register 64 performs other real-time functions in addition to decoding, the cash register 64 can respond when it is ready and available to the image capture unit 62 without having to dedicate itself to the unit 62. Thus, for example, if the cash register 64 is conferring with the data storage unit 68, it need not abort the effort to service the capture unit 62. Instead, the effort can be completed without having to worry about losing synchronization with the capture unit 62.

The system of FIG. 1F might be used in a retail environment wherein the image capture unit 62 scans bar codes on items to be purchased. Because decoding functions are performed by the cash register 64, the portable image capture unit 62 will be a low power, low cost unit. In a typical retail installation, a central data base of item prices will be stored in the data storage unit 68 and accessed by a plurality of cash registers (not shown).

FIG. 2A is a diagram illustrating a schematic block diagram illustrating an embodiment of the circuitry underlying the coded image capture and decoding systems of Figs. 1A-F. In particular, a coded image capture and decoding system 200 comprises an image capture unit 202 and a host unit 204 coupled to one another by a communication link 206. The image capture unit 202 comprises an image processor 210, an image buffer 216, an optical unit 214, an interval timer 212 and interface circuitry 218. The host unit 204 comprises a host processor 220, conventional hardware 226 and interface circuitry 228.

The image capture unit 202 attempts to capture a plurality of coded images for batch decoding by the host unit 204. This attempt involves the optical unit 214 capturing a predetermined number of reflected images, for example five (5), and delivering each as they are captured to the image processor 210. Upon receipt, the image processor 202 applies proximity screening rules to each reflected image if this option is selected. If a reflected image fails to meet the proximity rules or if the proximity screening option is not selected, the image is rejected and not stored within the buffer 216. Otherwise, if a reflected image passes the proximity rules, the image processor 210 considers the reflected image a "coded image" and stores it in the buffer 216. After the predetermined number of reflections are captured, the image processor 210: 1) resets the interval timer 212 to time out after approximately 0.5 seconds; 2) suspends the capturing of further reflected images; 3) attempts to contact the host unit 204 if two (2) or more images are stored in the image buffer 216 (i.e., "2" being a minimum threshold); and 4) places the capture unit 202 in a low-power consuming state. The predetermined number of images captured, the minimum threshold and the time out period may be adjusted to accommodate the specific hardware and coded images at issue.

In particular, after accepting or rejecting the predetermined number of reflections, if the image buffer 216 contains at least two (2) coded images, the image processor 210 attempts to notify the host unit 204 of the need to perform decode processing. Otherwise, if less than two (2) coded images are stored in the image buffer 216, the image processor 210 concludes that the stored image probably cannot be decoded and, therefore, the image processor 210 will not attempt to notify the host unit 204.

Upon time out of the interval timer 212, the image processor 210 exits the low-power consuming state and repeats the capture cycle by directing the optical unit 214 to capture of another set (the predetermined number) of reflected images, applying proximity screening, resetting the interval timer and, if justified, attempting to notify the host unit 204. Thus, at 0.5 second intervals, the capture unit 202 attempts to capture, screen and store a set of images for batch decode processing by the host unit 204.

Upon notifying the host unit 204 that a set of coded images await decode processing, the image processor 210 enters a low-power consuming state awaiting either a time out of the interval timer 212 or a communication from the host unit 204. If the interval timer 212 times out, the image processor 210 repeats the capture cycle, attempting to gather another set of coded images. However, the image processor 210 does not overwrite or erase the set of coded images stored in the image buffer 216 for which the host unit 204 was notified, until: 1) an acceptable subsequent set of coded images (i.e., a set of at least two images) has been stored in the image buffer 216; 2) three (3) capture cycles or intervals have lapsed -- casting away aged images; or 3) the host unit 204 retrieves that set of coded images.

Thus, for laser scanning optical units, during capture cycles, a user would typically observe a series of short periods of illumination of the coded image each separated by slightly longer periods without illumination. The illumination periods would each last approximately 0.1 to 0.2 seconds, for example, depending on the number of images that are being captured. The periods without illumination would correspond to the time out period of the interval timer 212 of approximately 0.5 seconds.

In one setup mode, the capture cycling repeats indefinitely so long as read processing is enabled, for example via the enable button 22 of FIG. 1A, whether or not a successful decode occurs. The optical unit 214 may be directed from one coded target to another without having to trigger or retrigger. During this process, the host unit 204 screens multiple decodes of the same coded target, requiring manual user intervention to accept intentionally repeated reads. Such manual intervention might be prompted and received through a display and keypad, respectively, for example. However, in another setup mode, the repeated capture cycling is only continued until the host unit 204 decodes a single set of coded images. Thereafter, the code read processing of the system 200 will remain idle until it is re-enabled, for example, through retriggering. In this mode, a user would typically observe repeated on off cycling that terminates after a coded target has been decoded.

Although in the present embodiment at least two (2) coded images must be stored in the image buffer 216 to justify a decode processing attempt by the host unit 204, more or less images may be required based on a desired level of performance in a particular environment and with a particular coded target type. Moreover, although the benefit of proximity screening of what appears to be non-code images from the host unit 204 often outweighs the additional processing required by the image processor 210, in other embodiments, such is not always the case. In such embodiments, the image processor 210 may be configured to directly store all reflected images that are captured in the image buffer 216 and always notifies the host unit 204 to perform decoding.

The image processor 202 operates via the interface circuitry 218 to coordinate delivery of the notification through the interface circuitry 228 to the host processor 220. The specific nature of such coordination depends on the specific characteristics of the communication link 206. In FIG. 1A, for example, the interface circuitry 218 and 228 may comprise UART's (Universal Asynchronous Receiver/Transmitters) for delivering the notification and coded images to the host unit 204 across a serial wired link 206. Alternatively, the link 206 might comprise a wired parallel link, for example.

Similarly, in FIGs. 1D-F, the communication link 206 constitutes a wireless link. As such, the interface circuitry 218 and 228 would comprise wireless transceivers. Moreover, although FIGs. 1A-D and 1F illustrate a communication link 206 that is dedicated to communication with a single host unit 204, FIG. 1E illustrates both that the communication link 206 may comprise many relaying elements and that the link 206 may be used by pluralities of capture units 202 to access a single host unit 204. Similarly, although (not shown) a single capture unit 202 might utilize the same communication link 206 to access ones of a plurality of host units for decode processing. Likewise, the communication link 206 could be shared to accommodate non-decode processing functionality. In such cases, the host processor 220 may not respond to an attempted notification because the attempt itself never reached the interface circuitry 228. This would occur either when access to the communication link 206 could not be achieved by the interface circuitry 218 or when the attempted communication itself failed successful delivery over the link 206.

Upon receiving a notification from the image processor 210 that coded images await decoding, the interface circuitry 228 attempts to contact the host processor 220. Although the host processor 220 might be configured to poll the interface circuitry 228 to identify incoming notifications whenever the host processor 220 becomes available, in one embodiment, the interface circuitry 228 attempts to contact the host processor 220 by delivering an interrupt to the host processor 220. In particular, when a set of coded images have been stored in the image buffer 216, the image processor 210 delivers a "decode request" byte to the interface circuitry 228 via the interface circuitry 218. In response, the interface circuitry 228 delivers an interrupt to the host processor 220.

When the host processor 220 happens to be in an idle or low-power state or is currently performing a lower-priority task, the host processor 220 will not have the interrupt masked and, therefore, will immediately respond by vectoring to execute decode service routines 222. When the host processor 220 is engaged in a task of higher-priority or which requires or significantly benefits from real-time uninterrupted attention, the host processor 220 masks the interrupt from the interface circuitry 228. When masked, the interrupt from the interface circuitry 228 is not considered by the host processor 220. However, upon removing the mask, the host processor 220 will detect the pending interrupt and immediately vector to execute the decode service routines 222. Masking permits the host processor 220 to better service conventional hardware 226 and associated software applications.

If the host unit 202 successfully decodes a set of buffered images, the host unit 202 indicates the occurrence to the user through various interface means such as a display or speaker as described above. In addition, in the continuous reading mode, the host unit 202 is configured to ignore all notifications for a period of such as 1.5 seconds after a successful decode to prevent further decode processing of the same target or an unintended target in the path between the last decoded target and the next intended target.

Proximity screening rules may be based on reflected image strength or contrast. In the present embodiment, proximity rules for a one-dimensional coded target involves the screening of reflected images based on quite zone transition timing, the number of transitions and the code length. Specifically, the image processor 210 first counts the transitions of an incoming reflected image. If the number of transitions outside of a range required to even be considered one of the coded image types that might be encountered, the reflected image is rejected.

Similarly, if the length of the coded image is too long or short to be construed as one of the available coded image types, the image is rejected. Likewise, if the quiet zones leading up to the reflected image are too short to satisfy the quiet zone requirements of at least one of the code image types, the image processor 210 rejects the image. Other proximity rules might also be included. Similarly, some of these rules might be dropped. The trade-off is between image processor 210 capability and unnecessary host processor 220 attention.

The decode service routines 222 direct the host processor 220 to retrieve the set of coded images from the image buffer 216 via the interface circuitry 218 and 228 and the communication link 206. Once received, pursuant to the service routines 222, the host processor 220 performs decode processing, informs the user (via audio or display) of any decode success and returns to the task or idle condition it was in before vectoring. The host processor 220 may also inform the image capture unit 202 of success if termination of the capture process is desired (as in an alternate embodiment).

The host unit 204 includes a variety of modes of operation including full active, partially deactivated, and sleep modes. Thus, the host unit 204 may go into a sleep mode when its operation is not required. In fact, the host unit 204 may be in the sleep mode throughout a series of capture cycles wherein the target 224 is not yet in proximity. The host unit 204 is not dedicated to the decoding function. Moreover, once the coded images are received from the image capture unit 202, they may be stored in conventional memory and decoded as processing time of the host processor 220 happens to be available.

Similarly, with the present design, the capture unit 202 need not be restricted by the dedication of the host unit 204. If capturing images occurs rapidly in comparison to image delivery and decode processing times (for example with remote shared host units and/or two-dimensional image decoding), the capture unit 202 is able to enter a sleep or low power mode during the interval timer 212 time out instead of making possibly futile attempts to deliver a continuous stream of images to an unreachable or unavailable host unit for decode processing.

The sleep and/or idle times associated with the present design in both the host and capture units 204 and 202 conserve significant battery power. Similarly, power savings are also experienced in not dedicating the units 202 and 204 to servicing each other, i.e., by not requiring either of the units to wait, slow down or speed up based on the other unit's capabilities or limitations. Such power savings prove to be a significant benefit in portable applications such as is illustrated in FIGS. 1A-F.

The image buffer 216 comprises dynamic memory that may be written and overwritten as is required. The image buffer 216 could be a portion of another block of memory, such as system memory, or could be a separate structure dedicated to buffering the coded images. The image processor 210 has reduced heat generating characteristics, cost, size and power consumption as compared to a processor that performs decoding functions. Thus, the image capture unit 202 may be constructed smaller and less expensively than units that perform both image capture and decoding functions, opting to off load higher performance decoding requirements with a shared host processor.

FIG. 2B illustrates an alternative embodiment of a coded image capture and decoding system of the present invention utilizing laser scanning optics. The coded image capture and decoding system 250 comprises an image capture unit 252 and a host unit 254. The image capture unit 252 comprises an image processor 256, an image buffer 258, scan drive 262, scan drive coil 264, laser drive 266, a laser light source 268, signal conditioning circuitry 270, a photodetector 272 and an interface 278. In response to a read initiate button 260 (which may be within either unit 252 or 254), the scan drive 262 sets the scanning components in motion. Also in response to the read initiate button 26, the image processor 256 coordinates with the remaining portions of the capture unit 252 to capture and deliver in sets of images to the host unit 254 for decode processing.

In particular, the image processor 256 comprises digital circuitry that is programmable to execute instructions to produce images based upon the image data received from the signal conditioning circuitry 270. The image processor 256 communicates with and controls the image buffer 258, the scan driver 212, the laser drive 266, the signal conditioning circuitry 270, and the interface 278 to perform capture cycling. Thus, communication and control between the image processor 256 and the other elements within the image capture unit 202 comprises communication links that facilitate the requisite control functions and transfer of data. Such communication links include data, address and control busses and lines as required.

The image buffer 258 is coupled to the image processor 256 and the host processor 280 and comprises data storage that may be used to store the plurality of images. The image buffer 258 comprises conventional memory connected to the image processor 256, but might alternately comprise memory contained within the image processor 256 itself.

The host unit 254 comprises a host processor 280, a user interface 283, memory 286, conventional hardware 288 and an interface 292 that couples the host processor 280 to the capture unit 252 over a communication link 274. The communication link 274 could be a wired or wireless and shared or dedicated depending upon the installation. For example, consistent with the construction of the system 10 of FIG. 1A, the communication link 274 comprises a serial link that provides a relatively high-speed, dedicated data path between the image capture unit 252 and the host unit 254.

Typical conventional hardware 288 might include monitoring circuitry, wireless transceivers, wired modems, speech recognition and synthesis circuitry, etc., that may benefit from real-time dedication by the host unit 254. Typically, the host processor 280 communicates with other elements via control, data and address lines or busses in order to function with the elements within the host unit 254. Of course, depending upon the functionality of the respective element and the communication and control bandwidth required, the links between the elements within the host unit with vary.

In FIG. 1A, the user interface 283 comprises a separate keypad and display and audio circuitry. In FIG. 1B, the keypad and display are combined in the user interface 283. Other combinations and variations of user interface components and circuitry are commonly known and might also or alternately be employed.

Prior to initiation of the capture cycle, the components of the image capture unit 252 are in a low power mode to conserve battery life. A depression of the read initiate button 260 signals the image processor 256 and scan drive 262 to begin capture cycling. In response, the scan drive 262 drives the scan drive coil 164 to cause movement of the optical components that cause the scanning of the laser light that is emitted from the laser diode 268. For example, in some embodiments, the scan drive coil 164 oscillates one or more mirrors placed in the outgoing path of the laser beam from the laser diode 268. In others, the scan drive coil 164 rotates a hexagonal scanning mirror. Instead of oscillating or rotating mirrors, the scan drive coil 164 oscillates the laser diode 268 itself in yet other embodiments.

Also responding to the initiate button 260, the image processor 256 brings the remaining circuitry in the capture unit 252 out of the low power state to conduct the capture cycling. Afterwards, the image processor 256 coordinates and synchronizes the activity of the laser diode 268 via the laser drive 266 and the photodetector 272 via the signal conditioning circuitry 270 with the scan drive 262 to begin capturing reflected images. The image processor 256 processes the captured images using proximity screening and stores the screened images in the image buffer 258.

The read initiate button 260 directly controls operation of the scan drive coil 264 via the scan drive 262. In doing so, energy is often saved in that the oscillation or rotation caused by the coil 264 by maintaining ongoing oscillation or rotation, rather than terminating such movement immediately after a capture cycle has ended. Thus, during capture cycling, including the intervals that the laser diode 268 is turned off, the scan drive coil 278 will continue to cause oscillation, rotation or other motion. Only when the read initiate button 260 is released will the scan drive 262 stop driving the scan coil 264.

The read control button 260 also directly notifies the image processor 256 that capture cycling is desired. The image processor 256 responds by controlling the laser drive 266, signal conditioning circuitry 270, image buffer 258 and interface 278 while coordinating with the scan drive 262 to perform image capture cycling as previously described.

Although as illustrated, the read initiate button 260 is attached to both the image processor 256 and the scan drive circuitry 262, in an alternate embodiment, the read initiate button 260 is only attached to the image processor 256. Therein, the image processor 256 continues to drive the scan coil 264 via the scan drive circuitry 262 continuously during scan cycling so long as the read initiate button 260 is depressed. In either embodiment, at the initiation of a capture cycle, it is expected that the user would direct the image capture unit 202 toward the target 224 so that the read would result in collection of images that would include a coded image, such as a bar code. The laser drive 266 is initiated by the image processor 256 to cause the laser diode 268 to emit a laser beam that the scan coil 264 causes to be scanned across a target.

Signal conditioning circuitry 270 receives an electrical signal from the photo detector 272 that represents the reflected light intensity received by the photo detector 272 during a sweep of the target. The circuitry 270 squares and saturates the signal received from the photo detector 272 for delivery to the image processor 256 as a received image for proximity screening. If the received image passes proximity screening, the image processor 256 identifies the image as a "coded image" and stores it in the image buffer 258. The image capturing processing continues until a predetermined number of images have been captured by the photo detector 272. Thereafter, the image processor 256 delivers an interrupt signal to the host unit 254 via the interface circuitry 278.

The interrupt issued to the host unit 254 is a maskable interrupt that allows the host processor 280 to execute its other functions and to service the image capture unit 252 only when it has sufficient available processing time. As was previously described, the host processor 280 has additional functions to perform besides the decoding of images produced by the image capture unit 202. Many of these functions, for example, such as communication over the wireless link, may require real time, dedicated participation by the host processor 280. Such real time functions may require (or greatly benefit from) completion before the host unit 254 turns its attention to decode processing of the awaiting coded images. Thus, by using the maskable interrupt, the image capture unit 252 will not gain direct access to the host unit 254 unless the host processor 280 unmasks the interrupt.

The prior art devices dedicated the host processor 280 to decode functions during simultaneous capture and decode cycles. Because the image capture unit 252 obtained images much less quickly than a normal decode time, the host processor 280 waited for the images to arrive. Thus, the host processor 280 was underutilized and dedicated at the same time. Such usage of the host processor 280 not only wasted processing time but wasted power as well. Because the system of the present invention does not enable the host processor 280 to decode images unless it is available and unless the images are fully available, the system 250 of the present invention conserves energy as well as processing capability.

When the image capture unit 252 manages to interrupt the host unit 254, the host processor 280 executes a routine to decode the plurality of images stored in the image buffer 258. Even after being interrupted, the host processor 280 can still chooses to either: 1) fully respond by retrieving and decoding the images stored in the image buffer 258; 2) partially respond by retrieving and storing the images in the memory 286 for decode processing at a more convenient time; or 3) delay responding at all until a more convenient time. Thus, the host processor 280 can delay processing by masking the interrupt, delaying image retrieval or delaying decode processing and any combinations thereof.

Although only a maskable interrupt configuration is illustrated, in an alternative design, the host unit 250 could be configured to poll the image capture unit 252. Therein, when the host unit 250 is ready to perform decode processing, the host unit 250 polls the capture unit 252 to see if decode processing is needed. If so, the capture unit 252 will deliver the buffered images via the interfaces 278 and 292 for decode processing.

In the illustrated embodiment, the host processor 280 signals a user through an audible or visual feedback so that the user knows that a successful decode has been performed. Similarly, if a successful decode has not been performed by the host processor 280 for the images received from the image buffer 258, the host processor 280 signals to the user through the image processor 256 and/or reinitiates a capture cycle via the image processor 256.

The system 250 provides many important features that reduce the power consumption of the system 250. Further, because the host unit 254 is not dedicated to decoding during a capture cycle, the host processor 280 may accomplish other functions required of the host unit 254 during the execution of a capture cycle. Thus, the system 250 not only reduces power consumption, but also proves more efficient at managing multiple processing tasks including decode processing.

When the host unit 254 enters a sleep mode, the host processor 280 and conventional hardware 288 are placed in a low power consuming state. Upon receiving an interrupt from the capture unit 252, the host unit 254 only wakes those portions thereof that are required to perform decode processing, e.g., the host processor 280.

In an operation of the scan drive 262 and the laser drive 266 for one dimensional bar code scanning embodiments, the laser beam is swept from a starting sweep point (typically a leftmost location) to an ending sweep point (typically a rightmost location). The angle of this sweep is typically between ten and twenty degrees. Positional feedback is provided from the scan drive 262 to the image processor 256 for correlation with the squared and saturated image data received from the signal conditioning circuitry 270. In an alternative embodiment, the image capture unit 202 employs an array of charge coupled devices (CCD) as the photo detector 272 to capture the entire (1 or 2 dimensional) image of the target. As such, the scan drive circuitry 266 is not needed, and a flash illuminator replaces the laser drive 266 and laser diode 268.

FIG. 3 is a schematic block diagram which illustrates several of the possible variations in the design of the present invention. Even though FIG. 3 is by no means a disclosure of all possible variations, it should illustrate to one of ordinary skill in the art the types of variations that might be made without sacrificing the goals associated with the present invention. In particular, an image capture unit 310 (comprising a controller 322 and image capture circuitry 320) interfaces with a host unit 312 as described previously with a few possible exceptions. First, proximity functionality can be located within the image capture circuitry 320, controller 322, independent circuitry 338 or host unit 312. Moreover, the proximity functionality may be subdivided for coordinated operation at more than one of such locations. For example, all proximity screening could be performed by the controller 322 as represented by the dashed block 334. As such, the image capture circuitry 320 would deliver all images captured to the controller 322 for all proximity screening. Alternately, the image capture unit 310 could take on part the proximity functionality by incorporating proximity sensing within the image capture circuitry 320 or in additional independent circuitry 338. Such proximity sensing involves the use of an independent photodetector to gauge proximity based on reflected light strength in the circuitry 338, or the shared use of a single photodetector found within the image capture circuitry 320 as indicated by the circuitry 338. Similarly, proximity screening functionality (in part or in its entirety) might be moved within the host unit 312 as represented by a block 336.

Additional design variations are also possible. For example, instead of using an independent image buffer (as previously described), the controller 322 selected might include the image buffer therein, i.e., a buffer 340. Alternately, the image buffer might be placed within the host unit 312. In this latter configuration, although the host unit 312 must be available to receive and buffer images as soon as the controller 322 has processed them, a processor within the host unit 312 need not be interrupted by each image if the buffer 342 is directly associated with the communication link between the units 310 and 312. In other words, the overall benefits associated with not requiring a processor within the host unit 312 to operate in a dedicated mode can be realized no matter where the image buffer (or buffering functionality) happens to be placed.

In addition, although each entire image may be stored in the image buffer awaiting decode processing by a processor within the host unit 312 (as previously described), the images can be stored in a compressed form by using image correlation. Specifically, in one embodiment, the controller 322 stores a first of a set of screened coded images (i.e., a reference image) in its entirety within an image buffer. Thereafter, each of the set of screened coded images are compared to the first (reference) image and only the relative differences from the first image is stored. By storing only the differences, it may be determined that all of the plurality of images received are identical and only a single image need be decoded by the host unit 312. By selectively passing only differences along with the reference image to the host unit 312, the processing requirements of the host unit 312 and the burden on the communication link 344 are reduced. This technique also reduces the power consumption of the host unit 312. The integration of proximity functionality accomplishes similar benefits.

FIG. 4 is a flow diagram which illustrates the basic functionality of the image capture units of FIGs. 1A-F. The image capture unit waits in an idle or low power state at block 401 until it receives an indication to begin capture cycling as indicated at a block 403. Thereafter, the image capture unit responds at a block 405 by capturing, proximity screening and storing a set of images. If more than one image has been stored at the block 405, the image capture unit interrupts the host unit at a block 407, sets an interval timer at a block 409, and returns to the idle state at the block 401. If one or less images have been stored during the capture cycle at the block 405, the image capture unit concludes that the capture cycle was a failure and resets the interval timer at the block 409 and returns to the idle state 401.

Having completed the first capture cycle (involving the attempted capture of a predetermined number of images), the image capture unit waits in the idle state at the block 401 for either the host unit's response (to retrieve the buffered images) or the time out of the interval timer (signifying that another set of images needs to be captured). In particular, if the interval timer times out as indicated at the event block 403, the capture unit responds by performing another capture cycle via the blocks 405-409 and returns to the idle state at the block 401. This process of performing a series of capture cycles each separated by an interval time period is termed "capture cycling" herein.

When the host unit responds to an interrupt delivered in the block 407 as represented by a block 411, the image capture unit responds by resetting the interrupt (if need be) at a block 413, delivers the buffered images to the host unit at a block 415 and returns to the idle state at the block 401. The process of capture cycling and servicing the responding host unit continues until the image capture unit receives an indication to terminate capture cycling. As previously described, such an indication may be delivered in a variety of ways such as through a user's release of a depressed button or through the host unit's terminate signal, for example.

FIGs. 5a-c are flow diagrams which illustrate three embodiments of the many possible ways that the capture cycle of the block 405 in Fig. 4 can be carried out. Other embodiments will become apparent to one of ordinary skill in the art with reference to these three.

In FIG. 5a, a capture cycle involves the capture of "N" images which are screened for proximity with only proximate images being buffered. Specifically, at a block 501 the image capture unit sets a counter to a count of "N", captures an image at the block 503, and decrements the counter at the block 505. Thereafter, the capture unit applies proximity screening and checks to see if N has been decremented to zero at a block 507. Four conditions are possible at the decision block 507. First, if the image does not pass proximity screening and N is greater than zero, the image capture unit branches back to cycle through the blocks 503, 505 and 507 to capture and screen another image. Second, if N happens to be zero at the block 507 (indicating that the predetermined number of images has been captured) and proximity screening has failed, the image capture unit ends the capture cycle. Third, if N is zero and proximity screening has succeeded, the image capture unit branches to store the image in the image buffer at a block 509. Thereafter, the image capture unit encounters a decision block 511, and because N is zero, the image capture unit completes the capture cycle and returns to further processing as illustrated in FIG. 4. Fourth, if N is not zero at the block 507 and the image passes proximity screening, the image capture unit also branches to store the image in the image buffer at the block 509. Thereafter, at the block 511, because N is not zero, the image capture unit returns to the block 503 to capture, screen and process another image. Overall, following this flow diagram, the image capture unit captures N images, screens them, and stores successfully screened images in the image buffer.

FIG. 5b illustrates an second alternative embodiment of a single capture cycle shown in FIG. 5a. At a block 521, N is set to a predetermined value corresponding to the number of images to be stored during a capture cycle. Thereafter, the image capture unit repeats blocks 523 and 525 until a proximate image is identified. Once identified, the proximate image is stored and N is decremented at blocks 529 and 527, respectively. This process continues until N proximate images are stored as determined at a block 531. Thereafter, the single capture cycle ends.

FIG. 5c is a flow diagram which illustrates a third embodiment which illustrates the use of proximity screening techniques prior to the actual capturing of images. Such techniques might, as previously described, constitute the detection of a proximate object based on the strength of a received reflection, for example. Particularly, after setting the number of proximate images to be captured at a block 541, the image capture unit continually attempts to detect a proximate image at a block 543. Once detected, the image is captured and stored at blocks 545 and 549, and N is decremented at block 547. This process continues until N images determined to be proximate have been captured. Thereafter, at a block 551, the capture unit decides to end the capture cycle.

Alternately, proximity detection at block 543 may be removed. Doing so will produce an image capture cycle that captures N images whether they are proximate or not. Similar modifications can be made to FIGs. 5a and 5b with similar results. Of course other modifications are also possible. For example, in storing the images, only the first image can be stored as a reference image in its entirety with only the differences of the N-1 other images being stored, as previously described.

FIGs. 6A and 6B are flow diagrams representing another embodiment of the present invention that illustrate the operation of an image capture unit. In this embodiment, at a block 602, the image capture unit enters and remains in a low power state until an initiate read signal has been asserted at a block 604. Once the initiate read signal has been asserted, the image capture unit branches to a block 606 to selectively enable the operation of image capture unit components. For example, in reference to FIG. 2b, the capture unit might respond to an initiate read signal received from the button 260 by enabling operation of the scan drive 262 and image processor 256, which, in turn (as will be described), enables the laser drive

266 and signal conditioning circuitry 270.

The coil 264 associated with the scan drive 262, as was previously discussed, consumes a significant quantity of current when it first starts up. However, when the coil 264 associated with the scan drive 262 has already been started up, it requires a significantly lower amount of current to continue its operation through the capture cycle. Thus, depending on the specific implementation, the scan drive 262 may operate continuously until the initiate read signal has been removed by release of the button 260.

At a block 608, the image capture unit performs proximity detection. Proximity detection may require that only the scan drive 262, the laser drive 266 and the signal conditioning circuitry 270 be enabled along with a proximity detector. At a block 610, the image capture unit determined whether a valid target is present and within the range. If no target is present, the image capture unit 252 is again placed in a low power state at the block 602 to wait for another read initiate signal. However, in an variation of this embodiment, instead of returning to the block 602, the image capture unit branches after waiting a short duration to the block 608 after unsuccessfully identifying a target at the block 610 to reattempt proximity detection at the block 608.

From the block 610, if a target is present, the image capture unit captures an image at the block 612. Referring back to FIG. 2b, the capture process may include, for example, sweeping the laser beam across the target, and, at the same time, receiving reflected light with the photo detector 272. At a block 614, the image capture unit stores the image to the image buffer. Afterwards, the image capture unit proceeds to a block 616 to determine whether a capture cycle has been completed. Depending on the configuration, the capture cycle may terminate: 1) after a fixed period of time; 2) when the initiate signal has been released; 3) after a valid image has been decoded; 4) after a fixed number of proximate images have been stored; and/or 5) after a fixed number of images have been captured.

Upon completing the capture cycle, the image capture unit branches to a block 618 further proximity screening is applied to determine whether at least potential code images are present. The proximity screening at the block 618 may constitute, for example, looking at the number of transitions in each of the coded images 320 stored in the image buffer. Alternately, for example, the image capture unit may accomplish the screening at the block 618 may also be accomplished by comparing a reference image to the plurality of other images written to the image buffer. If substantial differences exist amongst the images, the image capture unit may conclude that a valid code probably does not exit in the stored set of images. No matter what the technique used for screening in the block 620, if the images pass the test, the image capture unit branches to interrupt the host unit at a block 622. Otherwise, the image capture unit branches to a block 632 to report the fact that capturing cycling is ongoing and returns to the block 602 to begin another capture cycle (so long as the initiate read signal is still applied).

After interrupting the host, the capture unit enters a wait state at a block 624 for the host to respond. Although not shown, a time out period is also initiated which, upon time out, the image capture unit branches to the block 602 to begin another capture cycle. If the host unit responds, the image capture unit transmits the stored coded images to the host unit for decoding. As represented by a block 630, the host processor decodes the images to produce a resultant code or to determine that no resultant code exists. Then, at a block 632, the user is either notified of the success or notified that capture cycling is ongoing. From the block 632, the image capture unit returns to the block 602 to begin another capture cycle. However, in an alternate configuration, upon detecting a valid code, the host unit causes the image capture unit to ignore the initiate read signal until the button is retriggered. As can be appreciated, operation pursuant to the illustrated embodiment utilizes object proximity to initiate the image capturing and decoding process while employing a read initiate signal from a button, for example, to enable object proximity processing.

Thus, the flow of operations of the embodiment illustrated in FIGs. 6A and 6B enable the capture systems of the present invention to operate in reduced power modes and reduced processing requirement modes. In this fashion, capture may be performed in a manner to reduce the consumption of power from a finite energy power supply such as a battery and also free up the operation of the host processors performance various other functions.

FIGs. 7A and 7B illustrate an alternative method or flow of operation of the systems of the present invention. The blocks identified in FIGs. 7A and 7B having names and/or descriptions similar or identical to corresponding blocks found in FIGs. 6A and 6B have similar or identical function. In particular, an image capture unit enters a low power state at a block 702 awaiting an initiate read signal at a block 704. If not busy, the host unit may also be in a low power state at this time to conserve battery life. Otherwise, the host unit may be engaged in servicing other hardware or software that may or may not benefit from real time dedicated processing by a host processor in the host unit.

When an initiate read signal has been received, the image capture unit branches to a block 707. At the block 707, the image capture unit selectively enables the operation of its components to accomplish the operation found in the further blocks. In accordance with previously described concepts and goals, only those components required are activated when needed. Thus, the block 707 is merely illustrative of actual enabling scope, sequence and timing. Thereafter, at a block 712, the image capture unit executes a read of the target, capturing an analog representation of the image. The image capture unit converts the analog representation into digital signal transition data at a block 714. The digital signal transition data constitutes a series of transition point markers that include a time stamp identifying the transition and the relative time of the transition occurrence. In another embodiment, instead of using a time stamp, the transition point markers identify each transition by identifying interval duration information.

Although a conversion to transition data is not necessary, the amount of data required to represent each captured image can be significantly reduced. Further reductions are achieved by only recording a reference image and differences found in each subsequent image (as previously described). By reducing the amount of data required, memory size and thus power is reduced. Also, the volume of data to be transferred from the image capture unit to the host processor is reduced. This not only reduces traffic on the communication link, but minimizes power utilization and speeds up the transfer time. Further, the processing requirements to decode images stored in a fashion where transition points are only considered will reduce the amount of host processing time required.

At a block 716, the image capture unit analyzes the digital signal transition data to determine whether the digital signal transition data constitutes a coded image. Although many proximity screening techniques may be employed (as previously discussed), in the present embodiment such a determination is made by counting the number of transitions existing in the digital signal transition data. If a code image is present in the data, the image capture unit will write the digital signal transition data to the image buffer at a block 718. Otherwise, the image capture unit ignores the transition data, considering it a non-code image. In either case, the image capture unit branches to a block 720 to determine whether the capture cycle is complete. If the capture cycle has been configured to constitute a fixed number of reads and that number has not been reached, the image capture unit will branch back to the block 712 to perform another read. Similarly, if the capture cycle has been configured to constitute a fixed number of stored images and that number has not been reached, the image capture unit will branch back to the block 712 to attempt to store another. In either configuration, once completed, the image capture unit branches to a block 722.

At the block 722, the image capture unit determines whether a code image criteria is met. In particular, to determine whether the stored images are suitable for decoding by the host unit 204, if valid code images exist in more than a predetermined number (at least one) of the stored images, the code image criteria is met. However, if the criteria were not met, flow would proceed to a block 724 wherein the capture unit determines whether another capture cycle is to be initiated or not. Factors considered at block 724 include proximity of a target (in some embodiments employing object proximity), whether a read initiate button 260 is still depressed, setup configurations and/or various other factors that would indicate whether additional capture may be desirable.

However, if code image criteria is met at the block 722, the image capture unit branches to perform the operations indicated by blocks 726 through 734. The blocks 726-34 correspond to the blocks 624-32 of FIG. 6B, respectively. Thus, these blocks need not be further discussed.

FIG. 8 is a flow diagram that illustrates another embodiment of the functionality an image processor of the image capture unit in processing captured image data. At a block 801, the image processor waits to begin receiving image data from an optical unit of the image capture unit via real time sampling of reflected image signals representing a coded image. Upon beginning to receive the image data (i.e., upon receiving or retrieving the first sample thereof), the image processor vectors at an event block 803 to start a time stamp timer 805. Afterwards, at a block 807, the image processor waits for the next sample of the image being captured. Once the image processor has the next sample, as represented by the event block 809, the image processor considers all transitions in recent image samples and performs filtering at a block 811 of transitions which appear to constitute noise. In other embodiments, the block 811 is not implemented, placing all noise filtering responsibilities on the host unit. Either way, at a block 813, the image processor considers the newly received sample to determine whether it constitutes a transition, i.e., from white to black or black to white, for example, as represented in the reflected image data representative of the coded image.

If a transition is not detected, the image processor returns to the block 807 to await another image sample. In this way, by cycling through the blocks 807, 809, 811 and 813, the image processor sifts through samples that do not constitute a legitimate transition event. If the block 811 is not employed, the image processor would still sift through the image samples to find transition events, but would occasionally, inappropriately identify the dirt, scratch or image defect as a legitimate transition. Many occurrences of dirt, scratches or defects can be filtered by considering the expected transition rate with the rate caused by the occurrence. Even so, some such occurrences will still often appear to be legitimate transitions and escape filtering. The capturing of multiple images when, for example, the user's aim changes slightly allows some of the images to avoid such occurrences in the image data.

When a transition is detected at the block 813, the image processor branches to a block 815 to record a time stamp as indicated by a time stamp timer. At a block 817, if this is the first captured image of the predetermined number to be captured during a capture cycle, the image processor stores the transition in an image buffer at a block 819, and returns to the block 807 to process another image sample. In this manner, the entire set of transitions for the first image captured will be stored in the image buffer by cycling through the blocks 807-19.

Once an entire image is processed, upon returning to the block 807, the image processor vectors through an event block 825 to return to the block 801 to reset the time stamp timer and await the processing of another image. When that image begins to be received, the image processor performs the functionality identified from the blocks 805-17 as previously described. However, because a first or reference image has been stored already (in the form of transition data), at the block 817 the image processor branches to a block 821 to compare the current transition information with the corresponding reference image transition. If the current transition information is different as indicated at a block 823, the image processor stores the transition at the block 819. If the transition information is the same, the image processor will not store the transition and returns to the block 807 to process the next sample. Thus, all subsequent images are processed the same way that the first image is handled with the exception that duplicate data is not stored.

Although in the preceding embodiment, the image processor operates to process the image data as it is captured, the entire flow diagram illustrated could also be processed after the fact by the image processor through retrieval of previously stored image data samples. Similarly, instead of waiting for receipt of real-time samples, the image processor might also be used participate to take the samples. Moreover, other techniques for identifying differences between images such us through various correlation techniques might be employed as an alternative.

FIG. 9 is a flow diagram illustrating the detailed operation of a host processor in one embodiment of the present invention employing interrupt masking techniques to isolate itself from the image capture unit when other tasks prove more important. Specifically, at a block 901 the host processor operates as any typical processor in a computing device, performing conventional processing tasks as the need arises. If a task benefits from the dedicated attention of the host processor, the host processor can be directed by associated task specific software to mask interrupts received from the image capture unit. Afterwards, when the task no longer needs dedicated attention, the interrupt is unmasked and the host returns to the idle or processing state at the block 901. This process is represented by the event blocks 903, 905, 907 and 909.

When the interrupt is not masked and an interrupt from the capture unit is received as illustrated by an event block 911, the host processor vectors to retrieve images from the image capture unit at a block 913. From the retrieved images, the host processor constructs a composite image at a block 915. To construct the composite image, the host processor first attempts to identify the most common transition sequence from all of the transitions of each image retrieved, discarding less common differences. In particular, transitions found in at least two thirds of the retrieved images are placed in the composite image. Any conflicting transitions in the other third of the retrieved images are not used in the composite image. Next, the host processor attempts to reconcile conflicts which cannot be resolved by a two thirds majority. Corresponding transitions having different time stamp information are reconciled by averaging the location of the time stamp for a transition added to the composite signal. Where transitions are present in some images but not in others (but neither controlling two thirds majority), a simple majority governs whether a transition will be added to the composite image or not. Other weighting factors and composite construction rules may supplement, modify or replace the aforementioned rules as proves beneficial.

After constructing the composite image at the block 915, the host processor attempts to decode the composite image at a block 917. If the attempt proves successful, as determined at a block 919, the host processor stores and/or forwards the decoded information for further processing and reports the success to the user at a block 921. Afterwards, the host processor returns to its idle or ongoing processing state at the block 901. By attempting to decode a composite image, the host processor is often more likely to decode the target image where no single capture of the image alone would have proven successful. For example, with very dirty or heavily scratched one-dimensional targets, each captured image might only provide an accurate representation of a portion of the overall code information originally recorded on the target. Subsequent captured images might also only correctly capture a portion. However, if the valid portions combined constitute a whole image, decoding can prove successful. This is often the case where capture cycling takes place while the unsteady nature of a human hand changes the code reading systems relationship to the a target.

If the attempt to decode the composite image fails at the block 919, the host processor branches to the block 923 to attempt to decode all of the retrieved images (i.e., all of the sets of transition information) simultaneously in parallel. Doing so saves a great deal of time over conventional serial processing techniques, because common areas of each of the retrieved images need only be decoded once. If only one of the parallel transition paths proves decodable (i.e., if only one successful decode result is produced), at a block 925 the host processor branches to block 921 to report and record the success before returning to the idle / processing state at the block 901. If two of the parallel transition paths proves decodable (i.e., if two or more successful decodes yield more than one result), the host processor, depending on the configuration of the host unit, either records and reports a failure at the block 927 or offers the choices to the user. A rejection by the user of all of the choices causes the host processor to branch to the block 927. Selection of one of the choices causes the host processor to branch to the block 921. In either case, the processor records and reports the result and branches back to the idle / processing state at the block 901.

FIG. 10 is a flow diagram illustrating an alternate embodiment where the host processor attempts to construct and decode a composite image only after attempting to decode each of the images retrieved from the image capture unit. A host processor first retrieves all of the transition information stored by the image capture device during a capture cycle. Thereafter, at blocks 1011 and 1013, the host processor accesses the first image and attempts decode processing. If the image is decoded, the host processor branches to a block 1017 to report the success and ends further decode processing. However, if the first image is not decoded, from a block 1015 the host processor branches to a block 1019 to consider whether there are any more images that have not received an attempt at decode processing. If other images are available, the host processor branches to get the next image at 1021 and attempt decode processing as before via the boxes 1015-19. This cycling repeats until either one image is decoded, ending the process, or no more images are available.

If no more images are available and no successful decode has been achieved, the host processor branches to blocks 1023 and 1025 to construct and attempt to decode a composite image (as previously described in reference to FIG. 9). The host processor reports success or failure in the attempt to decode the composite image at the blocks 1017 or 1029, respectively, and ends decode processing of the retrieved images.

FIG. 11 illustrates a further embodiment of the operation of a host processor in decoding images retrieved from an image capture unit, wherein an attempt at parallel decode processing is only attempted after an attempt to decode a composite signal fails. Together, FIGs. 9-11 illustrate that many other variations involving one or more of serial, parallel and composite decode processing are also possible.

More particularly, in FIG. 11, the host processor attempts to construct and decode a composite image at blocks 1111-15. Thereafter, if the attempt fails, the host processor attempts parallel decode processing at a block 1119. If either attempt proves successful, the host processor reports the success at a block 1123 before ending the process. Similarly, if both decode attempts fail, the host processor reports the failure at a block 1125 before ending.

FIG. 12 is a flow diagram illustrating another method for constructing a composite signal by averaging all images retrieved from the image capture unit before attempting to decode. At a block 1201, the host processor first aligns the images: 1) through correlation techniques such that images which are incomplete are appropriately aligned with other of the retrieved images; and 2) by scaling images if need be so that images gathered further away can be combined with those gathered closer to the image capture unit (e.g., while the user moves the code reading system toward a target during a capture cycle). Thereafter, at a block 1203, the host processor averages the sum of all of the retrieved images. As a result, the average image will appear somewhat analog in nature, and not merely represent white or black image elements. Instead the average image will constitute a gray-scale image.

At a block 1205, the host unit calculates a threshold value equaling fifty percent of the maximum possible amplitude of the gray-scale image. The calculated threshold is then applied to the gray-scale image to generate a black and white image, i.e., the composite image, at a block 1207. Specifically, any gray-scale level greater than the threshold is considered white, while the remainder is considered black.

With such a composite image, the host processor attempts decode processing at a block 1209. If successful, the processing terminates. Otherwise, the host processor branches to a block 1222 to identify a threshold margin, which is calculated to be ten percent of the maximum possible amplitude of the gray-scale image. At a block 1223, the host processor subtracts the threshold margin from the threshold then reattempts to generate the composite signal from the gray-scale image using as a threshold the previously calculated fifty percent threshold less the ten percent margin. Similarly, at the block 1223, the host processor reattempts to generate the composite signal from the gray-scale image using the fifty percent threshold plus the ten percent margin. With both reattempts compared to the original composite, the host processor identifies all differences at a block 1223. In other words, the host processor identifies all marginal regions.

By selectively altering the original composite image with some or all of the plurality of marginal differences, at a block 1224, the host processor attempts decode processing. Such attempts actually constitute a series of attempts wherein each attempt involves an alteration of the original composite image by inserting one or more of the plurality of marginal differences therein. This process continues until either a successful decode is achieved or all reasonable variations fail.

Although a ten percent margin with a fifty percent original threshold is disclosed, other percentages might also be adopted. Moreover, instead of using a marginal percentage value, the host processor might merely identify as marginal regions those sections of the gray-scale image that are closest to the threshold at the block 1223. Other similar techniques might also be employed.

Although the use of the term "processor" herein may refer to a single, processing component such as a microprocessor, it is meant to also include processing circuitry comprising multiple components that coordinate to carry out the underlying processing functionality described herein.

The above described preferred embodiments are intended to illustrate the principles of the invention, but not to limit the scope of the invention. Various other embodiments and modifications to these preferred embodiments may be made by those skilled in the art without departing from the scope of the following claims.

CLAIMS:

1. A coded image capture and decoding system comprising:

an optical system that captures image data from coded targets;

a first processing circuit, coupled to the optical system, that generates a plurality of images based on image data received from the optical system;

an image buffer, coupled to the first processing circuit, that stores the plurality of images generated by the first processing circuit; and

a second processing circuit, coupled to the image buffer, that, after the plurality of images are stored in the image buffer, attempts decode processing of the plurality of images.

2. The coded image capture and decoding system of claim 1 wherein the second processing circuit constructs a composite image from the plurality of images for decode processing.

3. The coded image capture and decoding system of any of the claims 1 and 2 wherein the plurality of images constitutes a predetermined number of images.

4. The coded image capture and decoding system of any of the claims 1-3 wherein the first processing circuit performs proximity screening of the image data from the optical system.

5. The coded image capture and decoding system of any of the claims 1-4 further comprising a proximity circuit which detects the presence of the coded target and initiates capture cycling.

6. The coded image capture and decoding system of any of the claims 1-5 wherein the second processing circuit attempts parallel decode processing of the plurality of images.

7. The coded image capture and decoding system of any of the claims 1-6 further comprising interface circuitry that assists in delivering the plurality of images to the second processing circuit for decoding after the plurality of images have been stored in the image buffer.

8. The coded image capture and decoding system of claims 7 wherein the interface circuitry utilizes wireless transmissions in the delivery of the plurality of images to the host processing circuit.

9. The coded image capture and decoding system of any of the claims 1-8 wherein at least one of the plurality of images constitutes a reference image for at least one of the other of the plurality of images.

10. The coded image capture and decoding system of any of the claims 1-9 further comprising control circuitry that selectively directs the host processing circuit to decode the plurality of coded images.

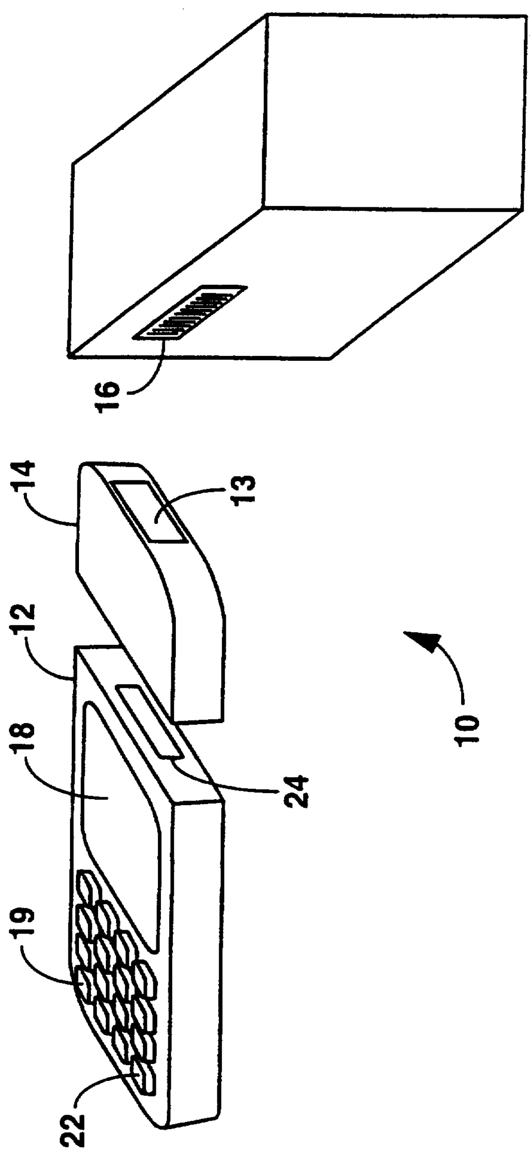

Fig. 1A

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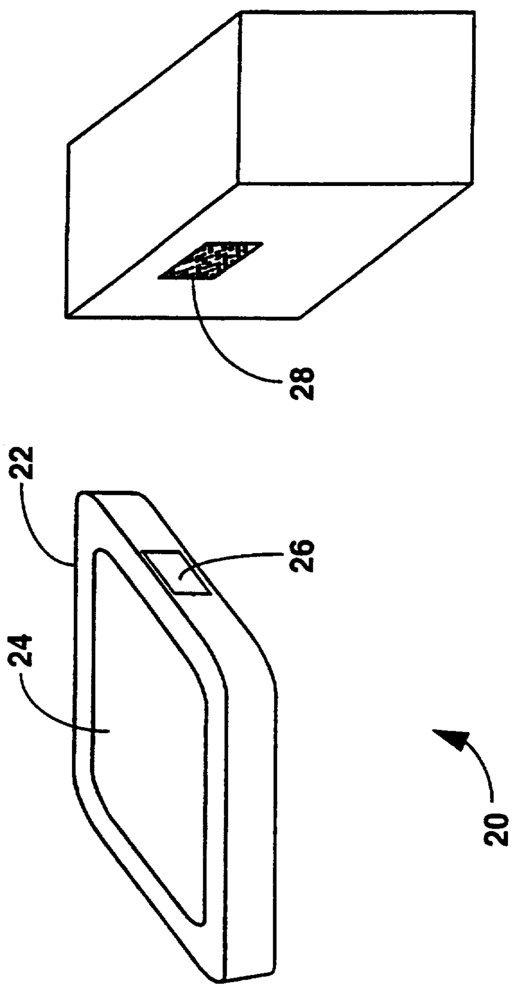

Fig. 1B

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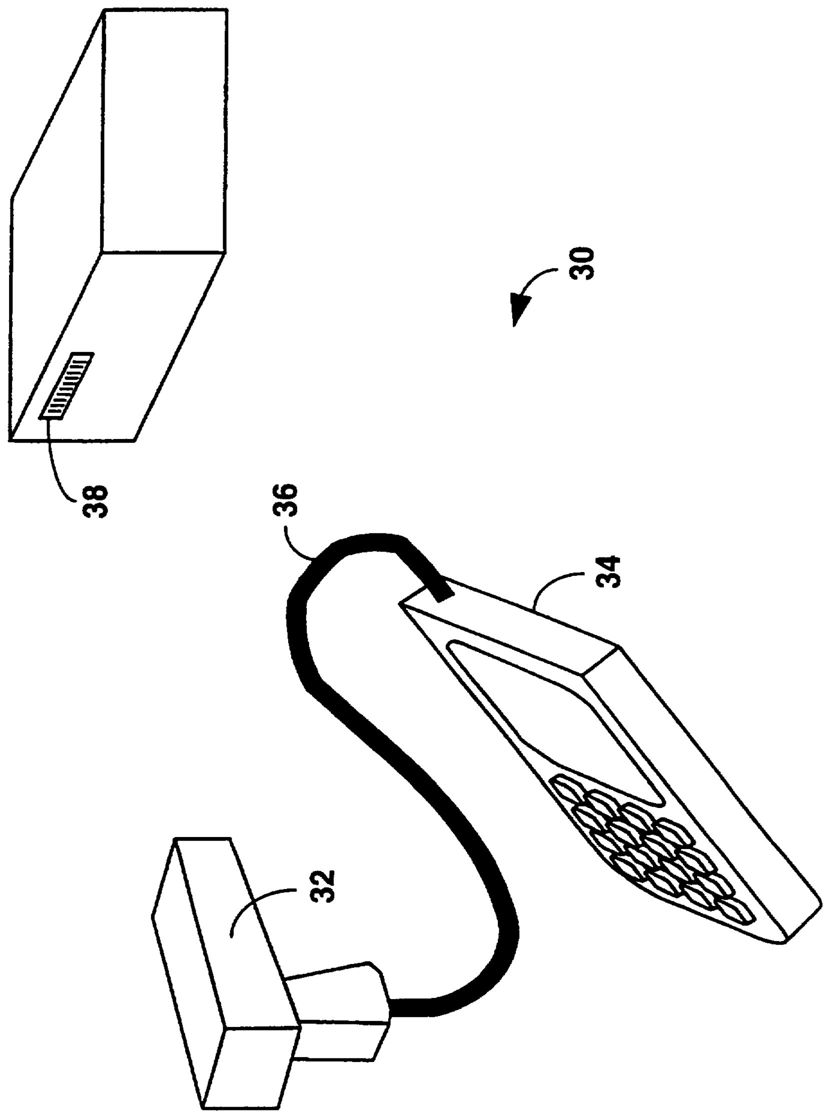

Fig. 1C

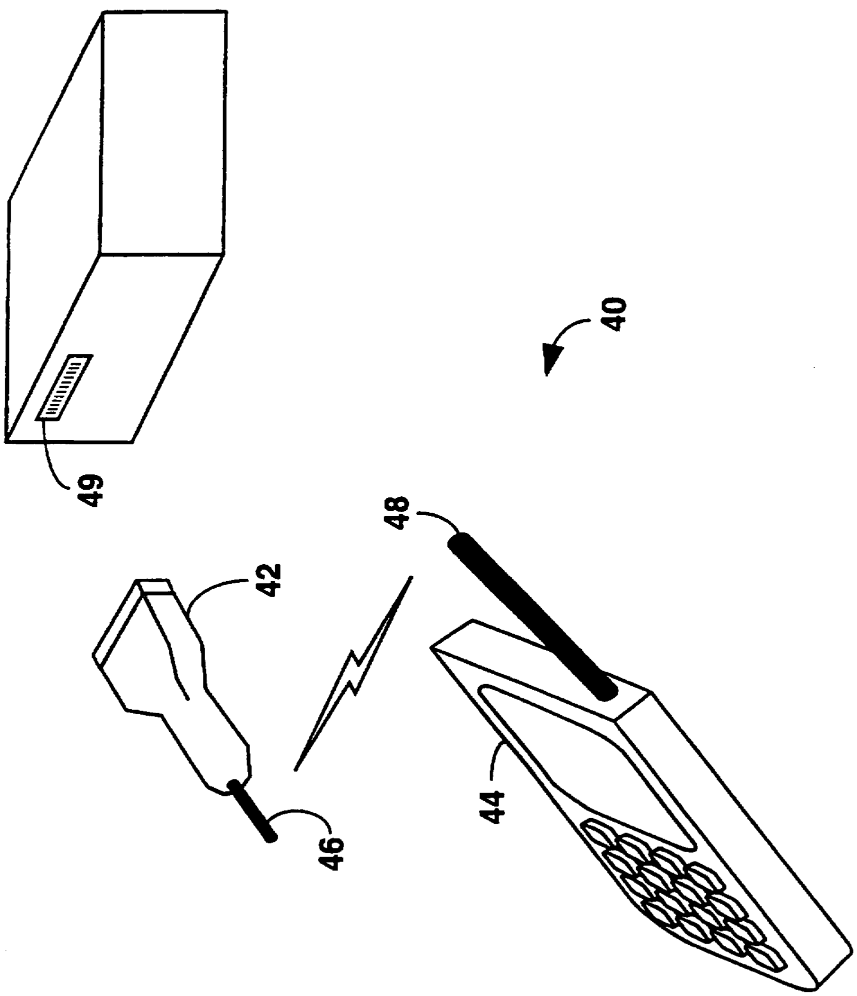

Fig. 1D

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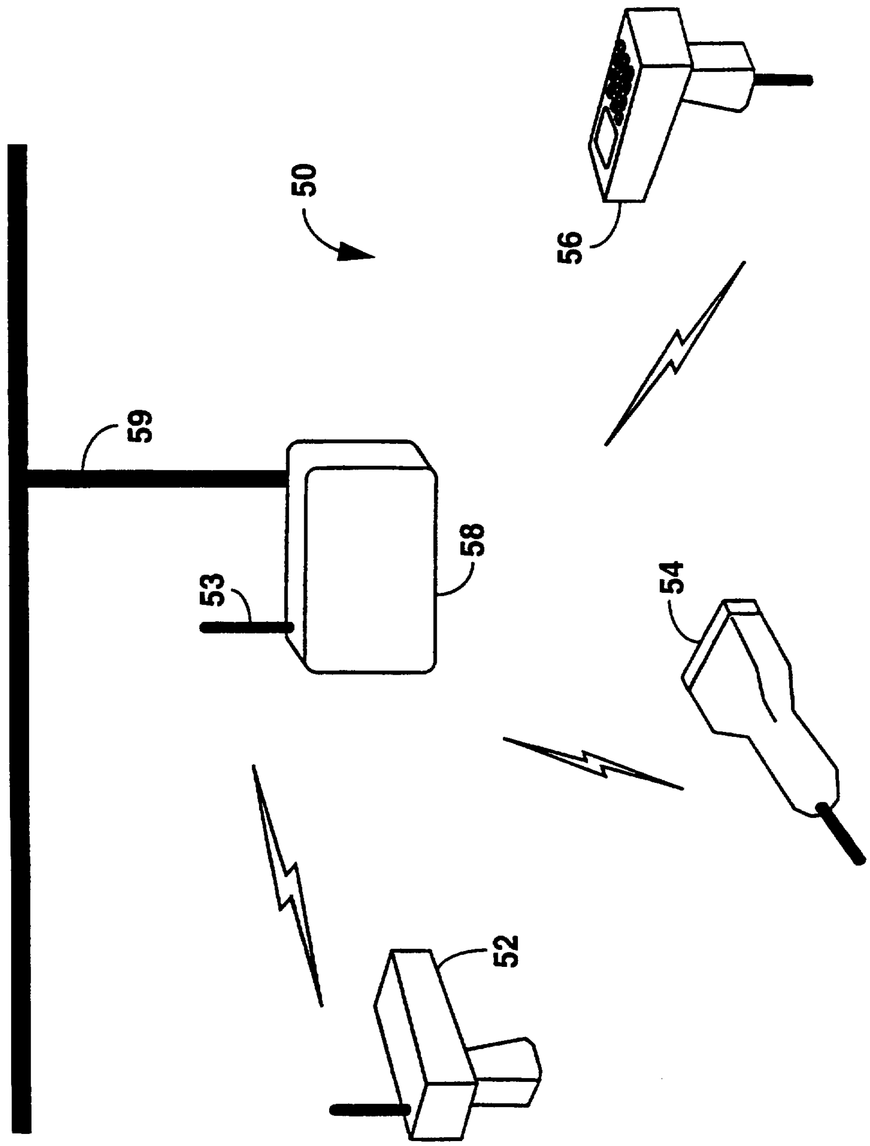

Fig. 1E

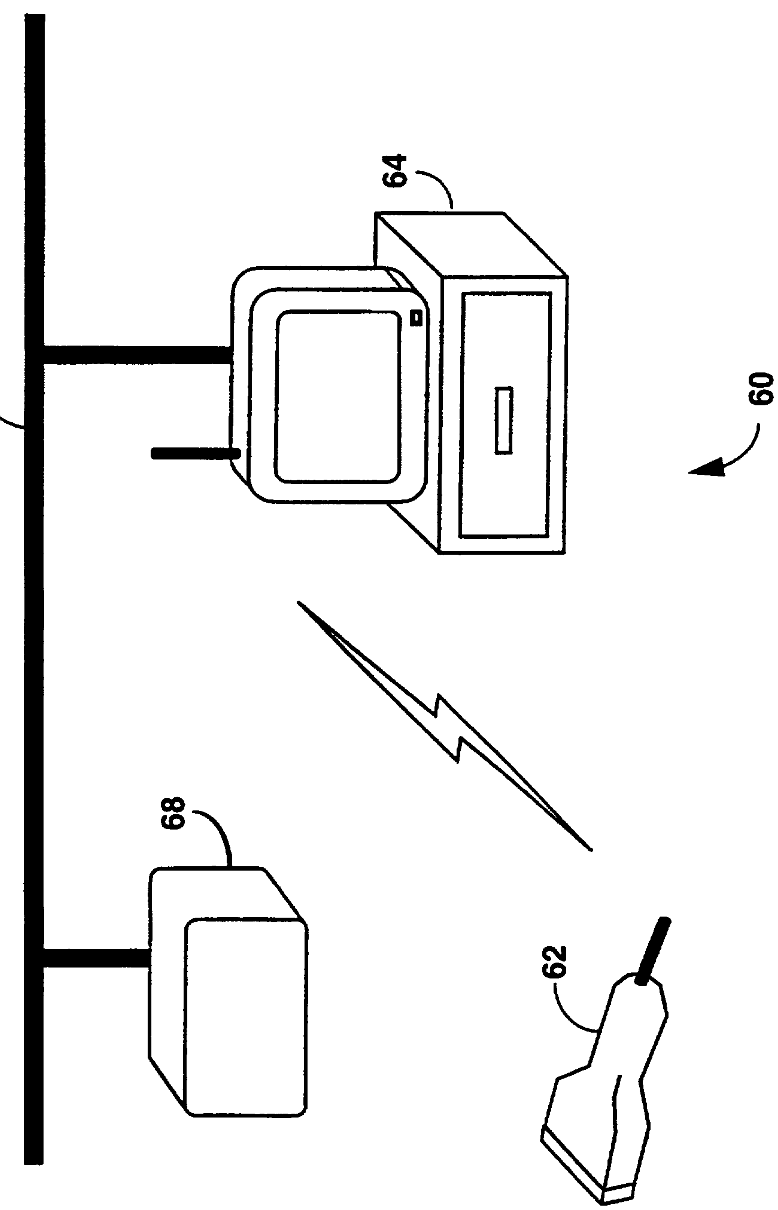

Fig. 1F

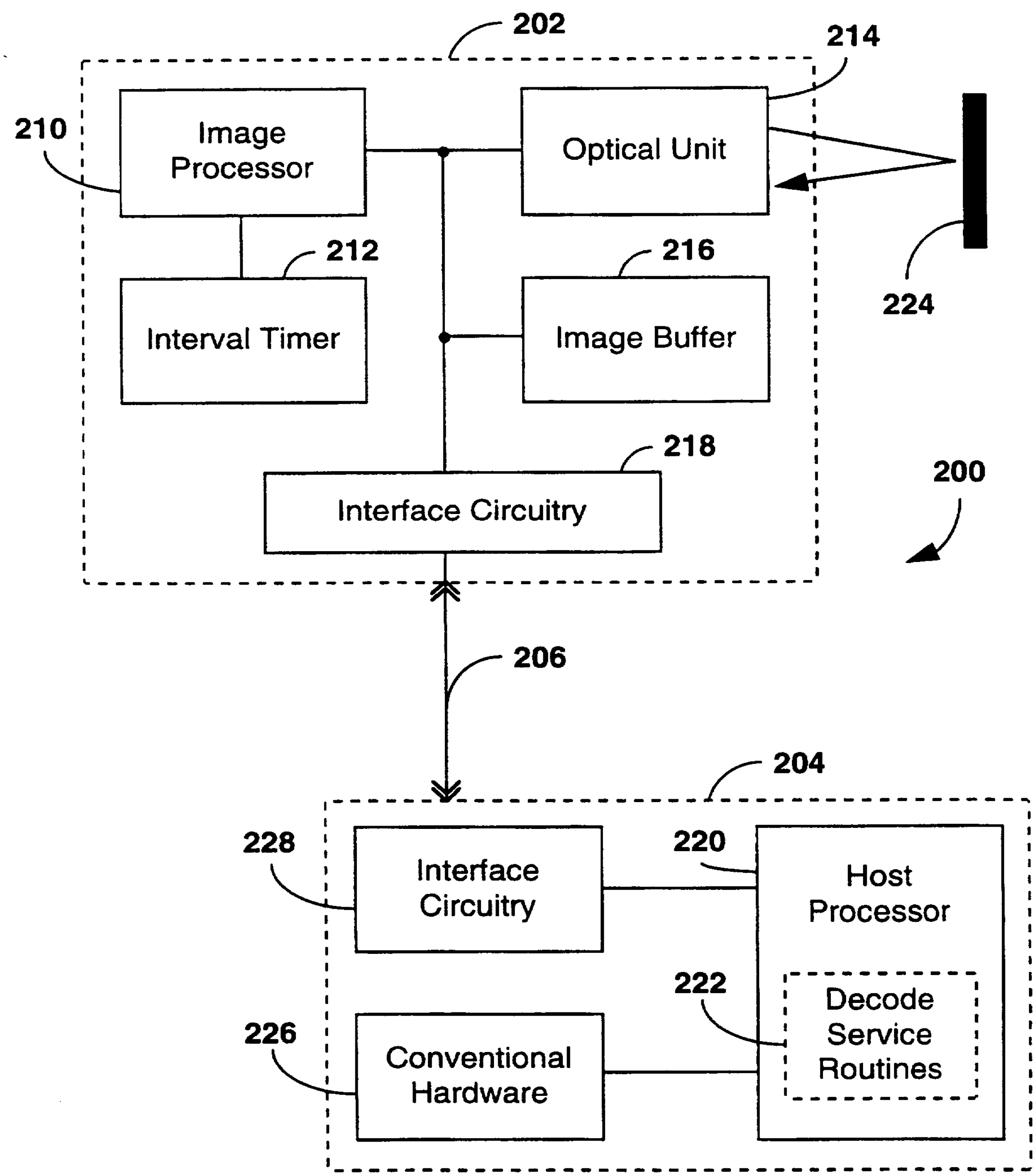

FIG. 2a

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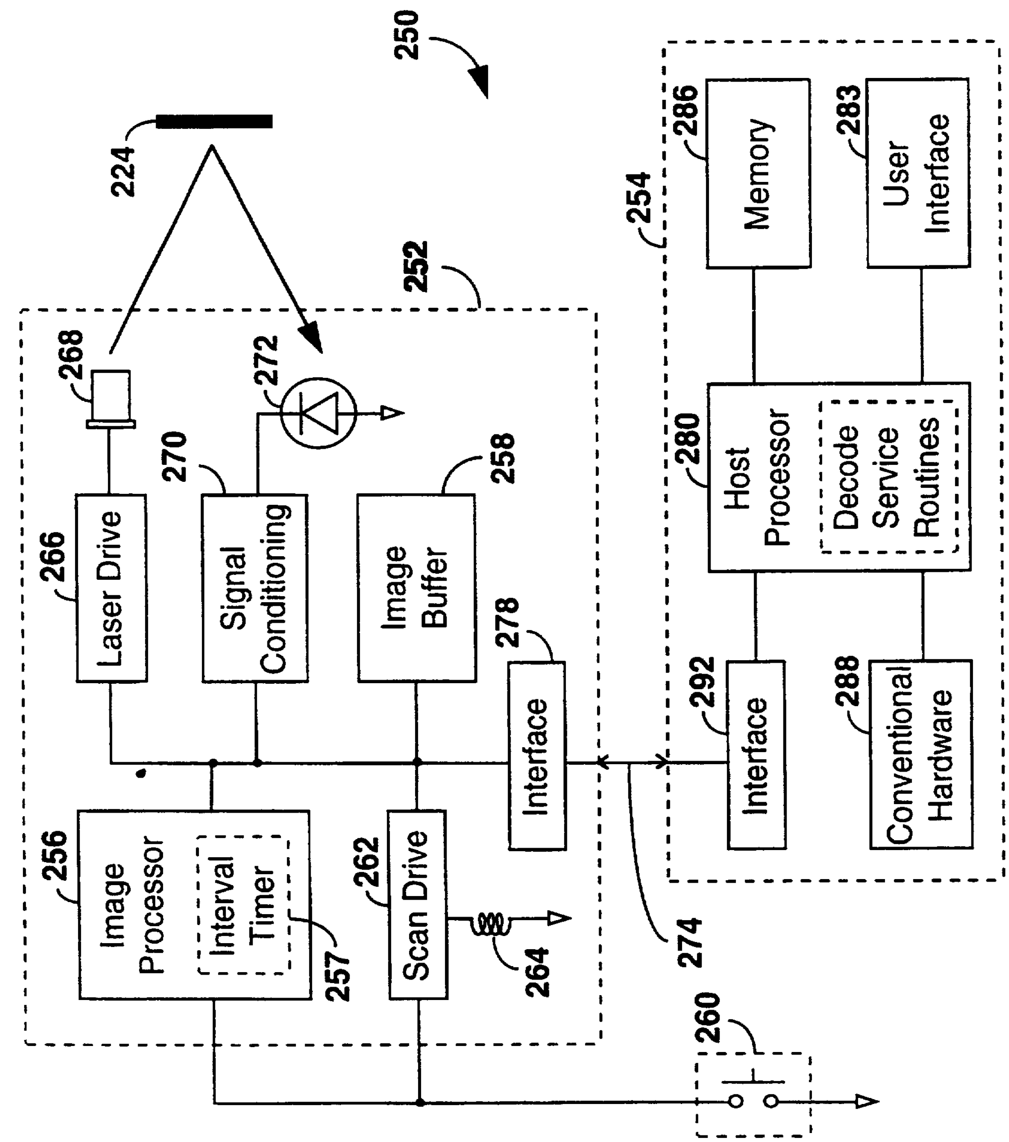
250
224
252
254
268
272
270
258
266
Laser Drive
Signal Conditioning
Image Buffer
278
Interface
256
Image Processor
Interval Timer
257
262
Scan Drive
264
274
260
286
Memory
283
User Interface
280
Host Processor
Decode Service Routines
292
Interface
288
Conventional Hardware

Fig. 2b

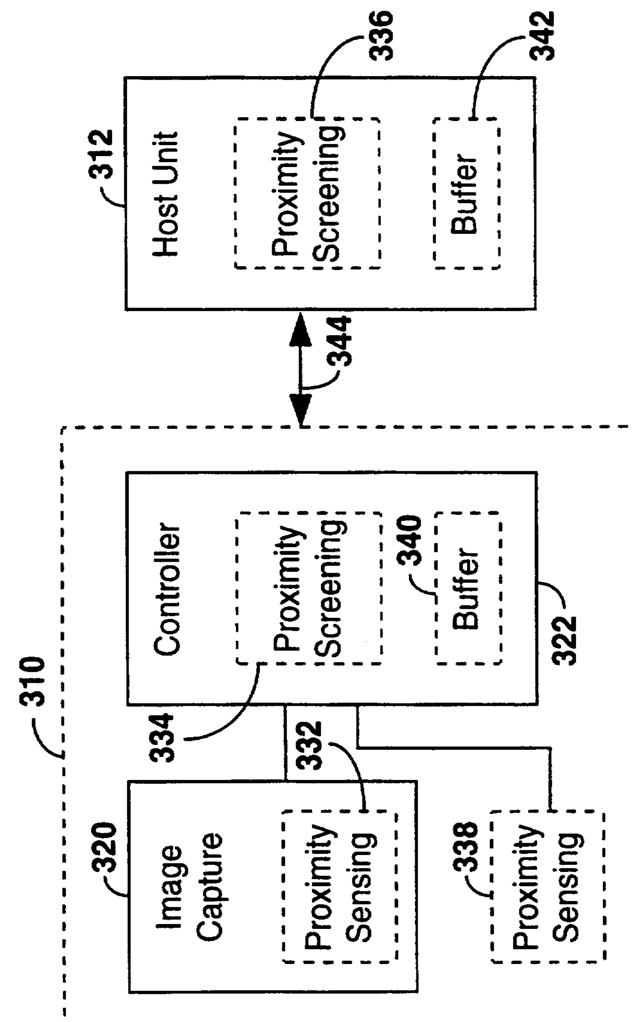
312
Host Unit
336
Proximity Screening
342
Buffer
344
310
Controller
Proximity Screening
340
Buffer
322
334
332
320
Image Capture
Proximity Sensing
338
Proximity Sensing

Fig. 3

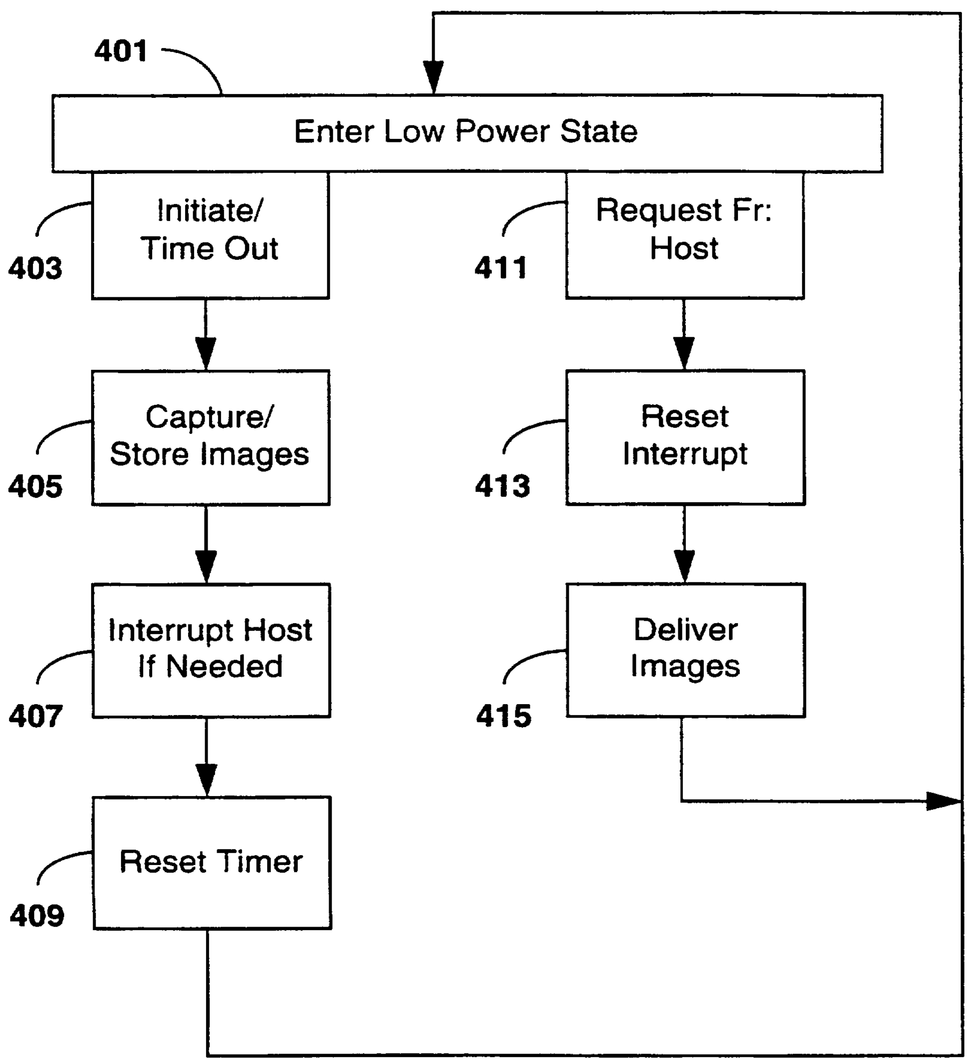

FIG. 4

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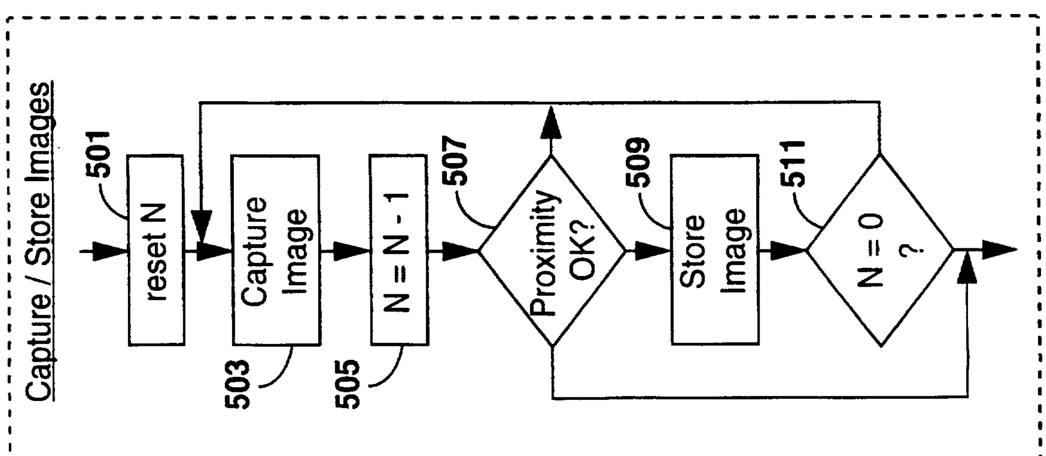

FIG. 5a

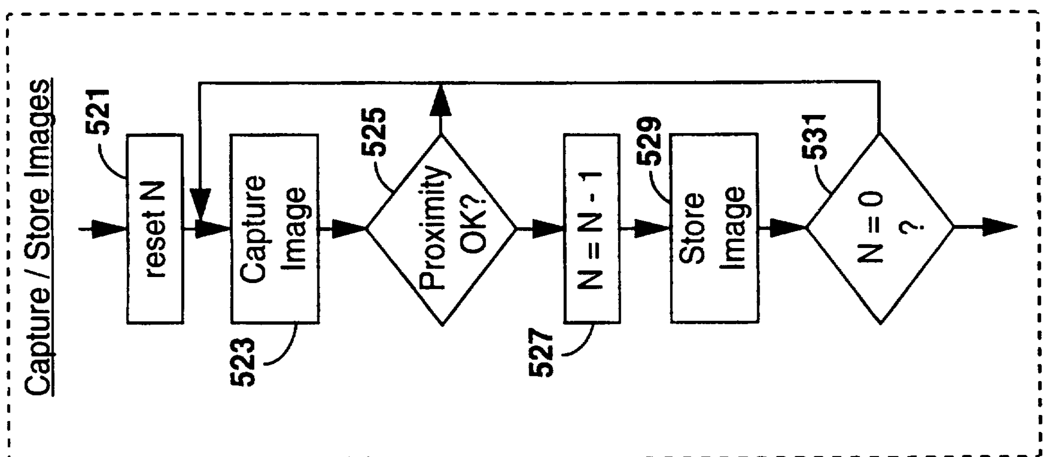

FIG. 5b

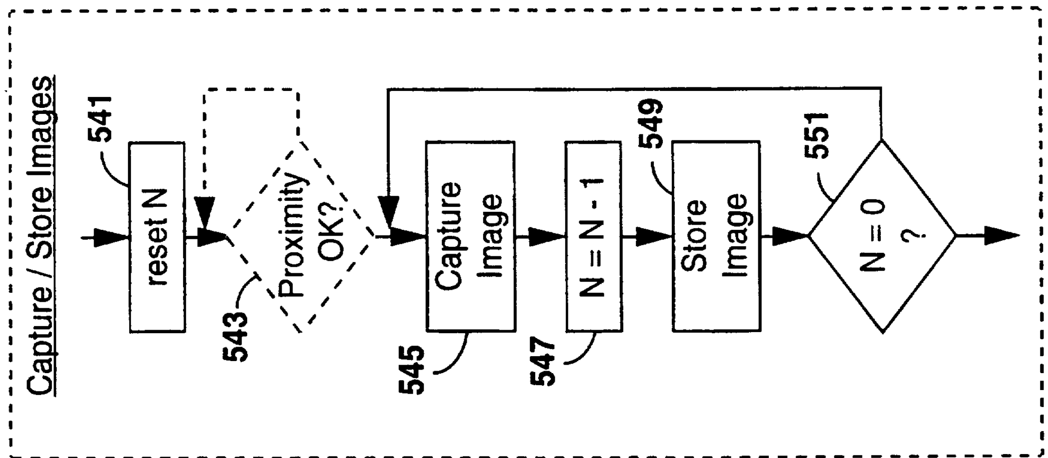

FIG. 5c

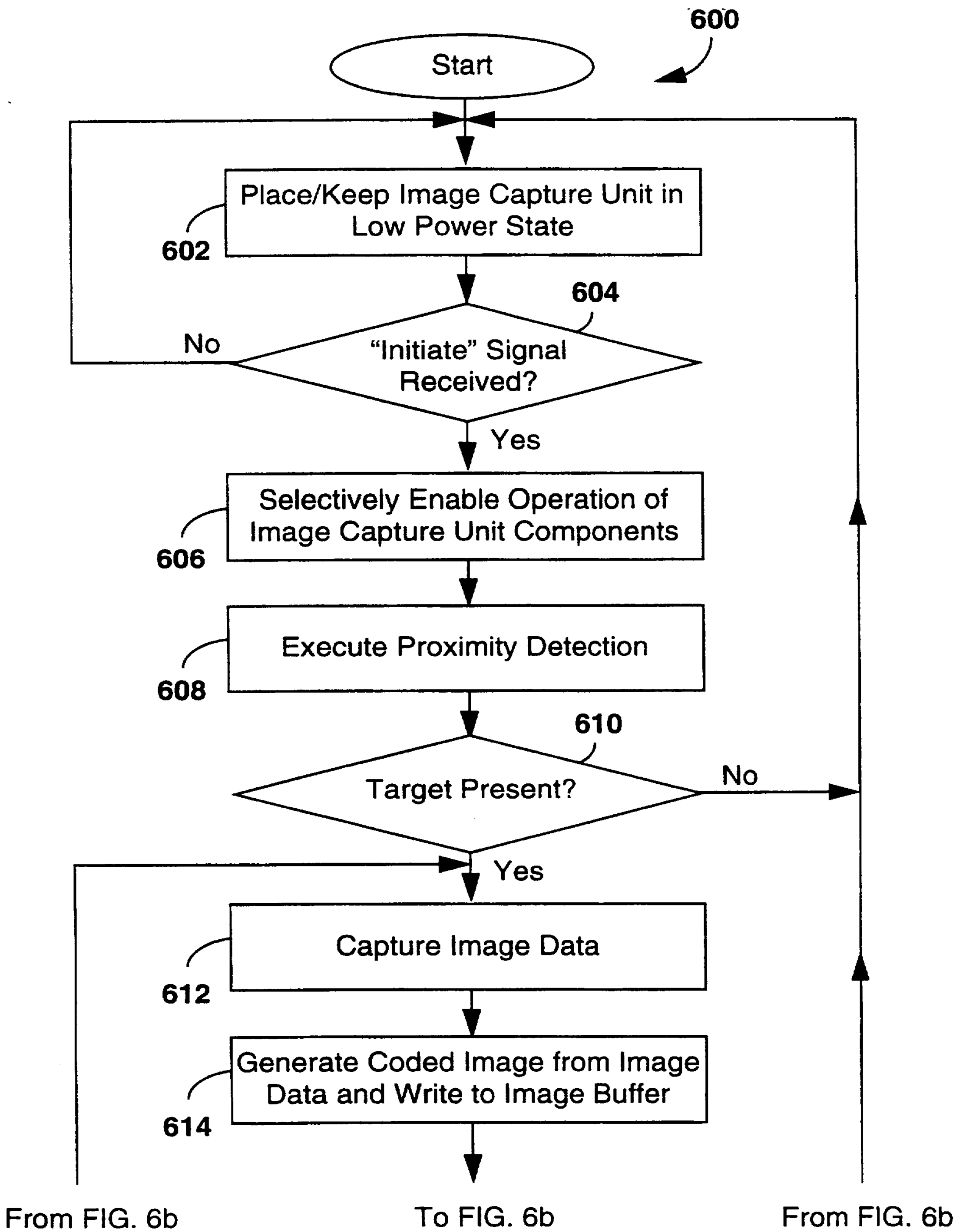

FIG. 6a

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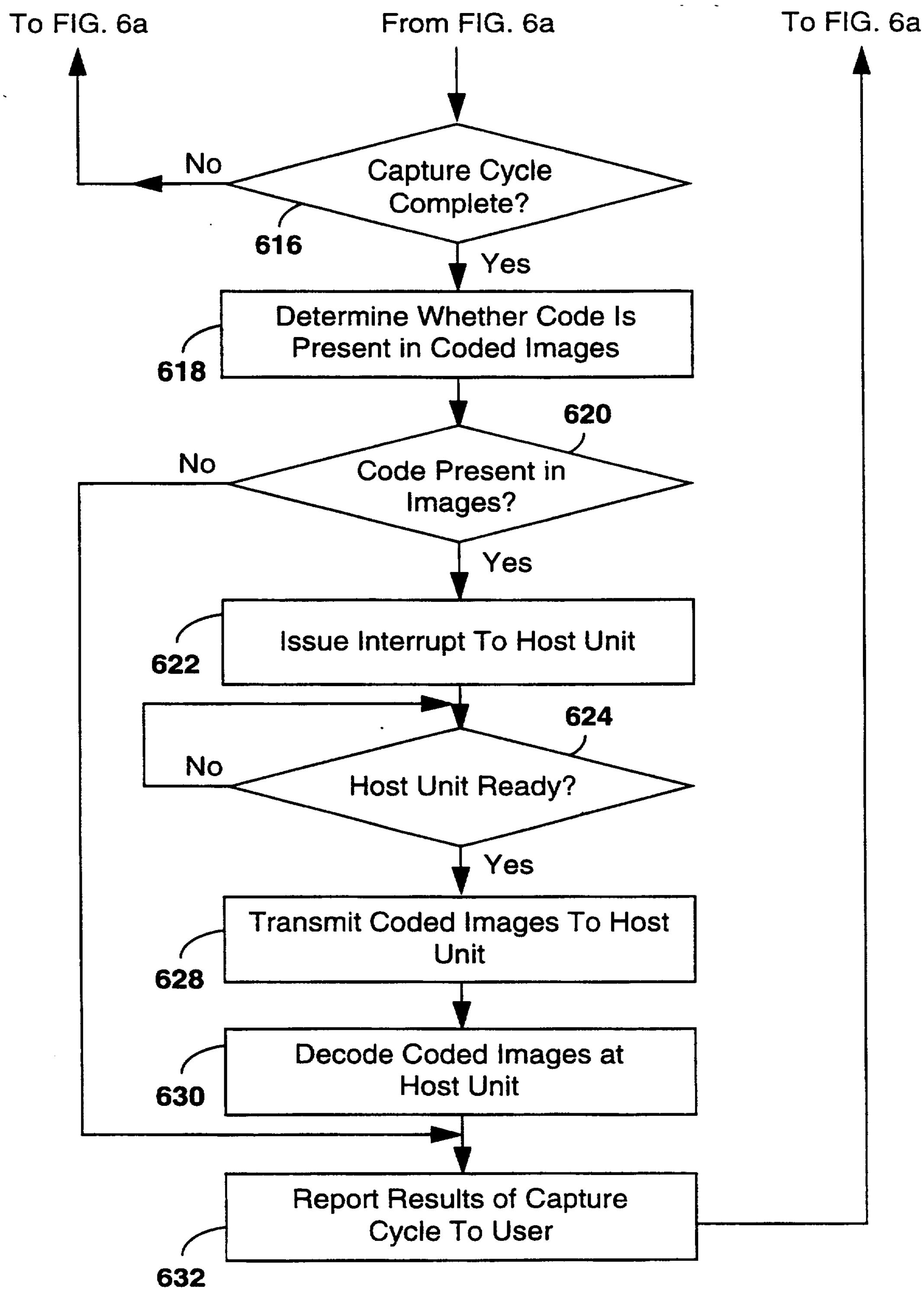

FIG. 6b

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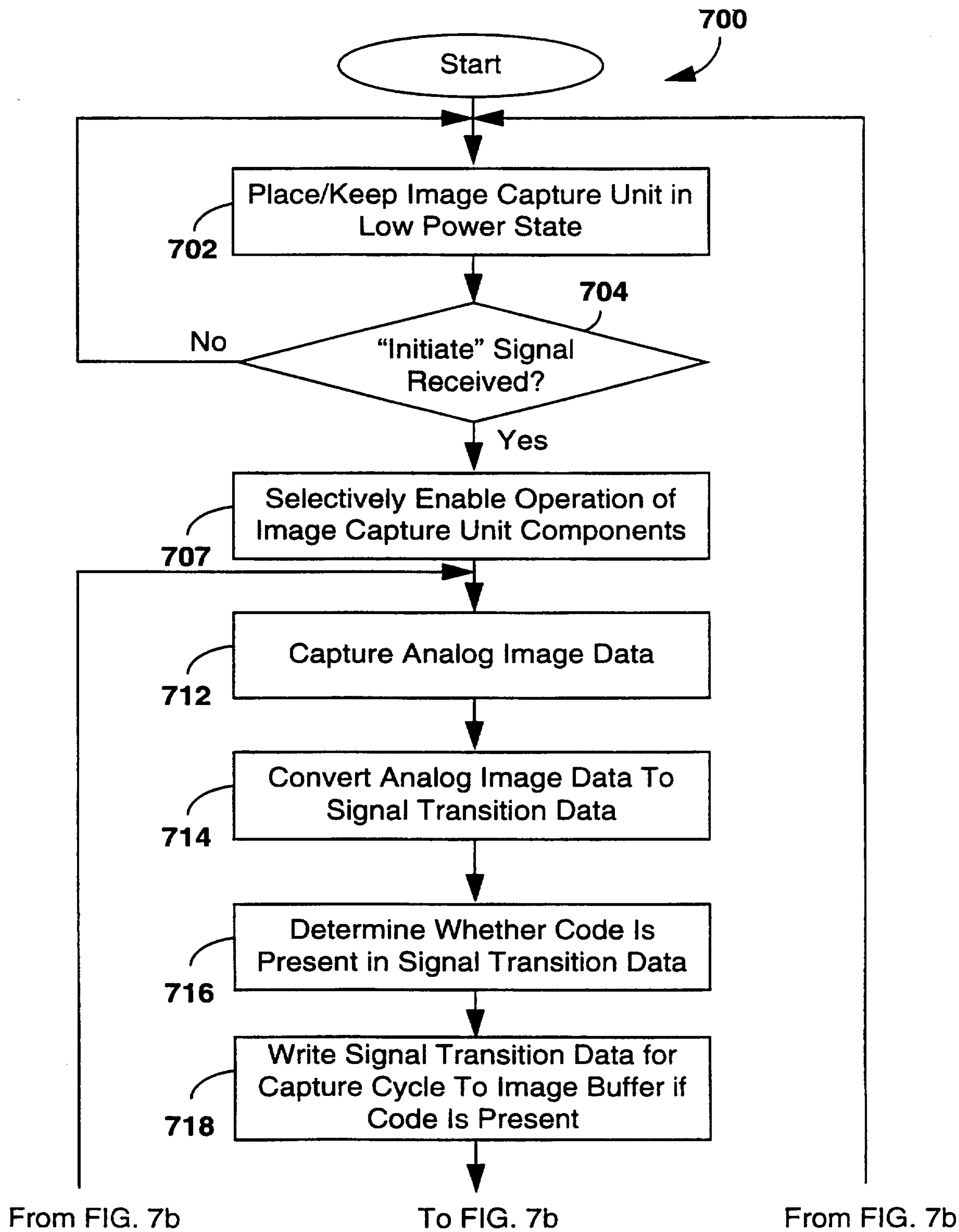

FIG. 7a

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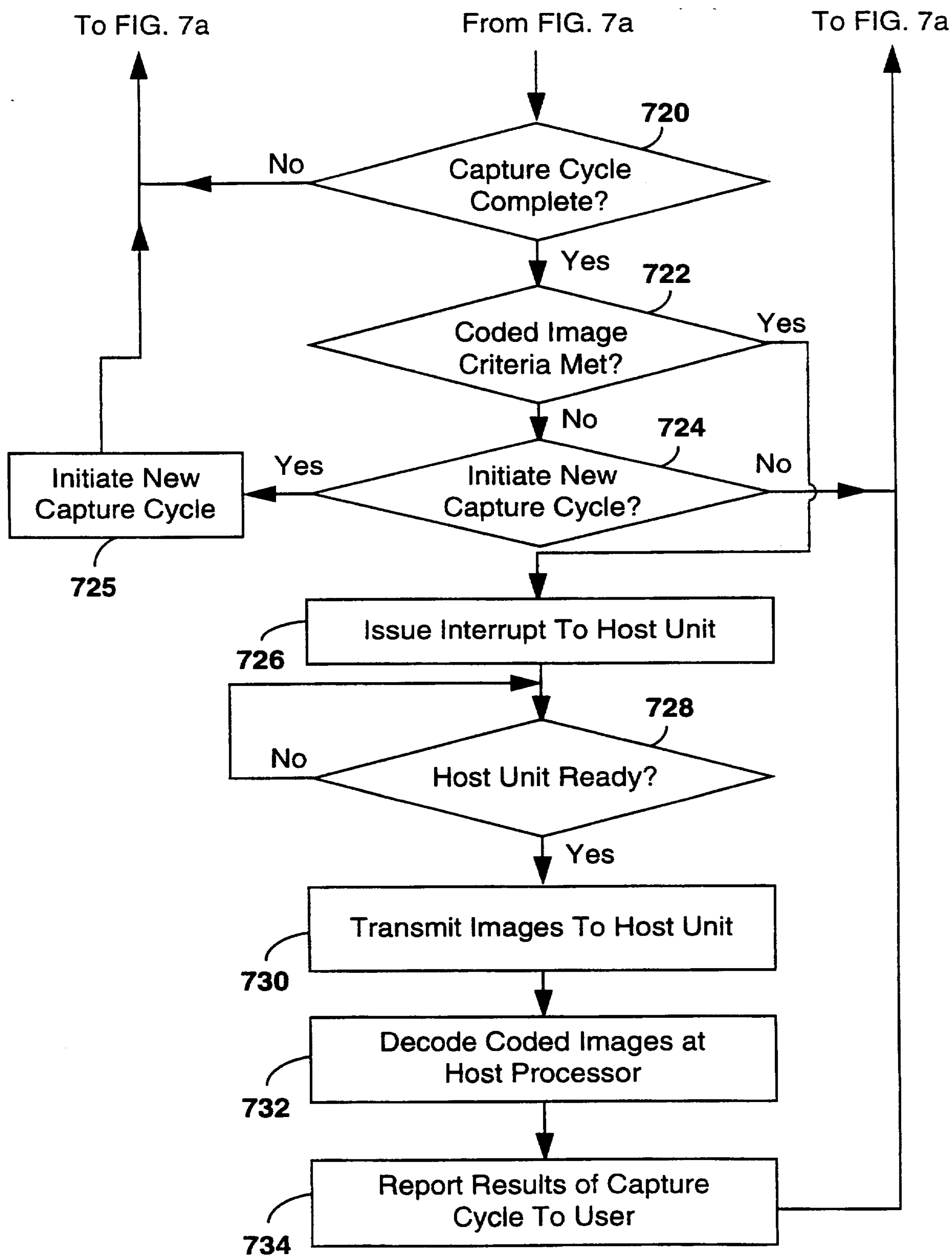
To FIG. 7a
From FIG. 7a
To FIG. 7a
720
Capture Cycle Complete?
No
Yes
722
Coded Image Criteria Met?
Yes
No
724
Initiate New Capture Cycle?
Yes
No
Initiate New Capture Cycle
725
Issue Interrupt To Host Unit
726
728
Host Unit Ready?
No
Yes
Transmit Images To Host Unit
730
Decode Coded Images at Host Processor
732
Report Results of Capture Cycle To User
734

FIG. 7b

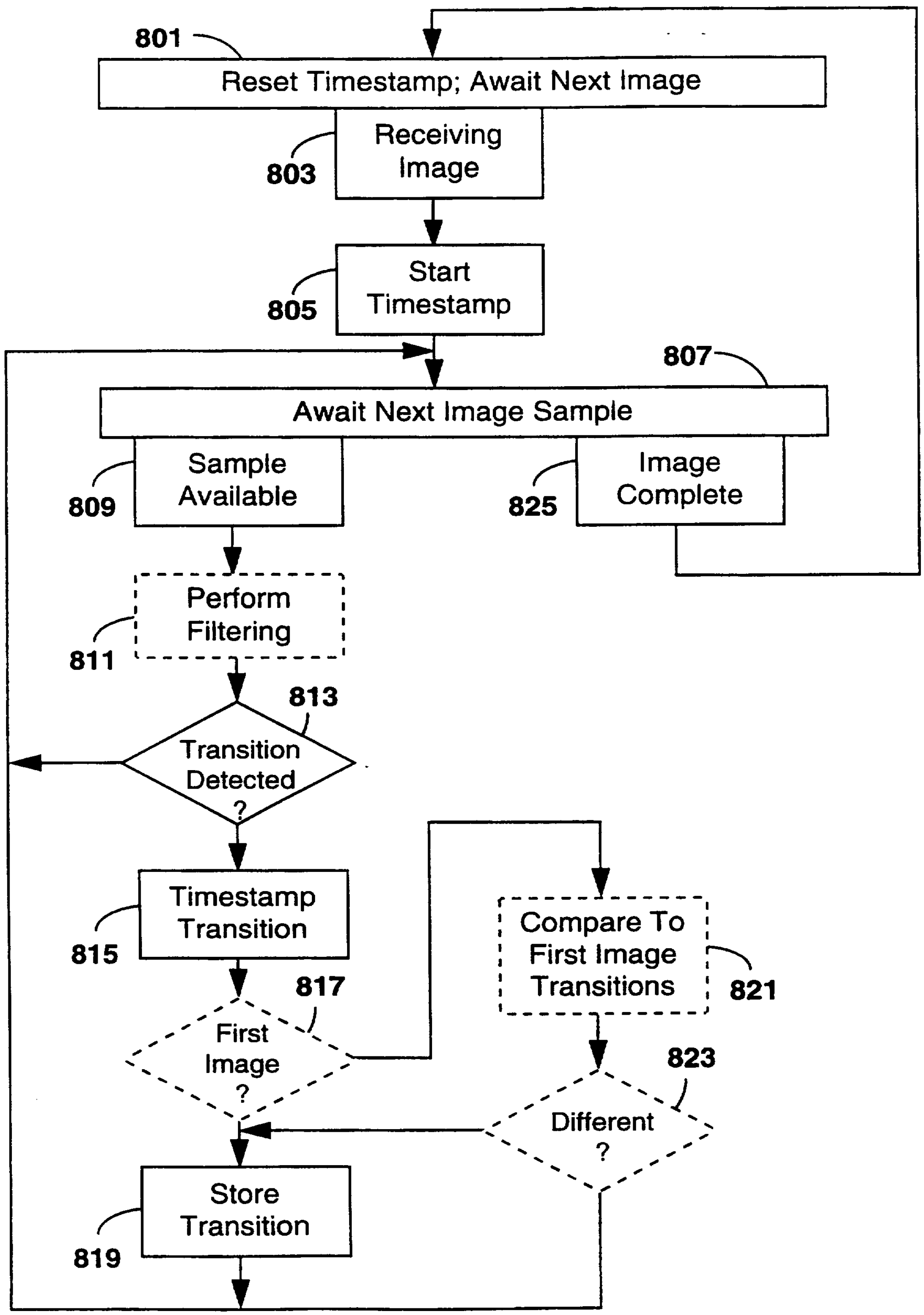

FIG. 8

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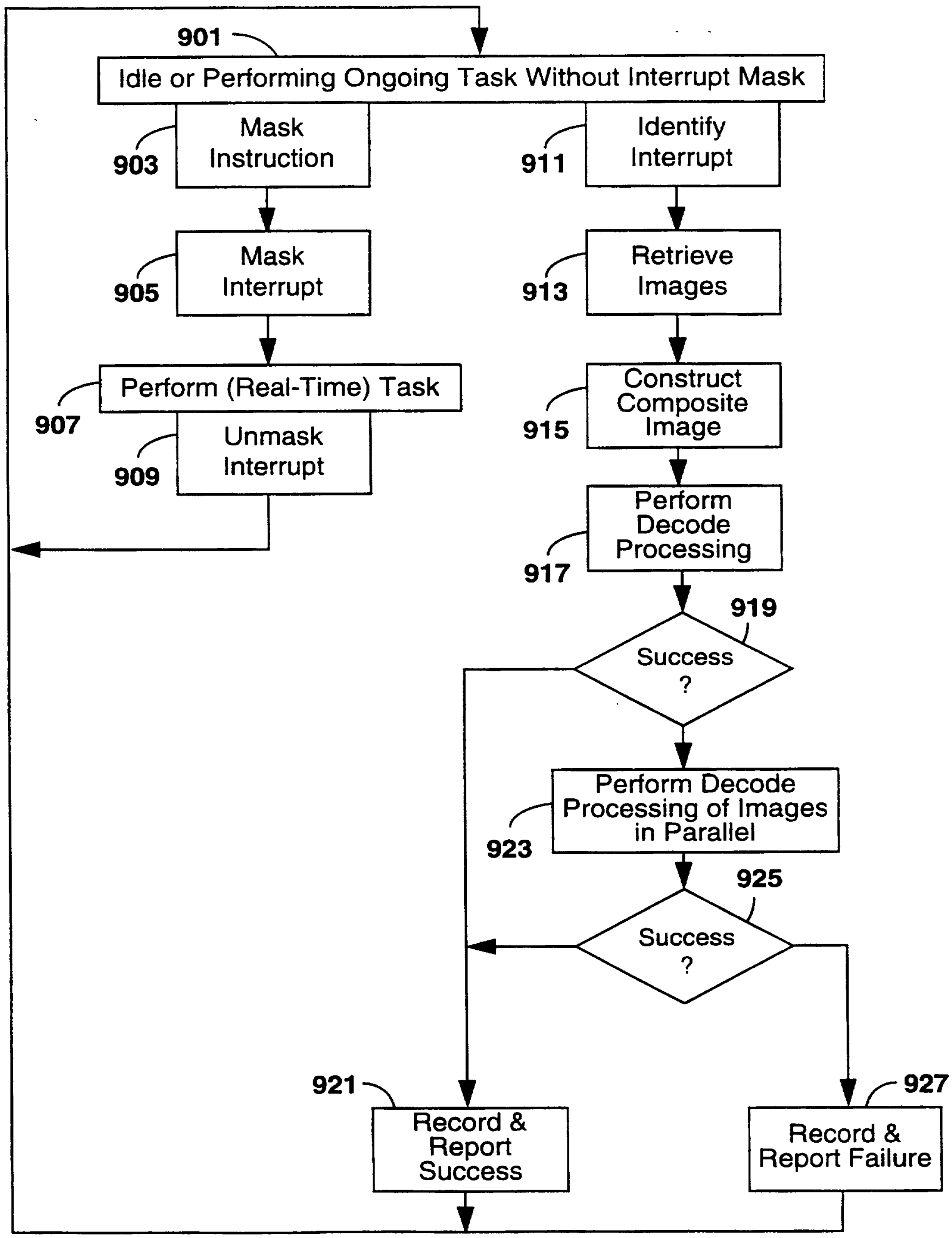

FIG. 9

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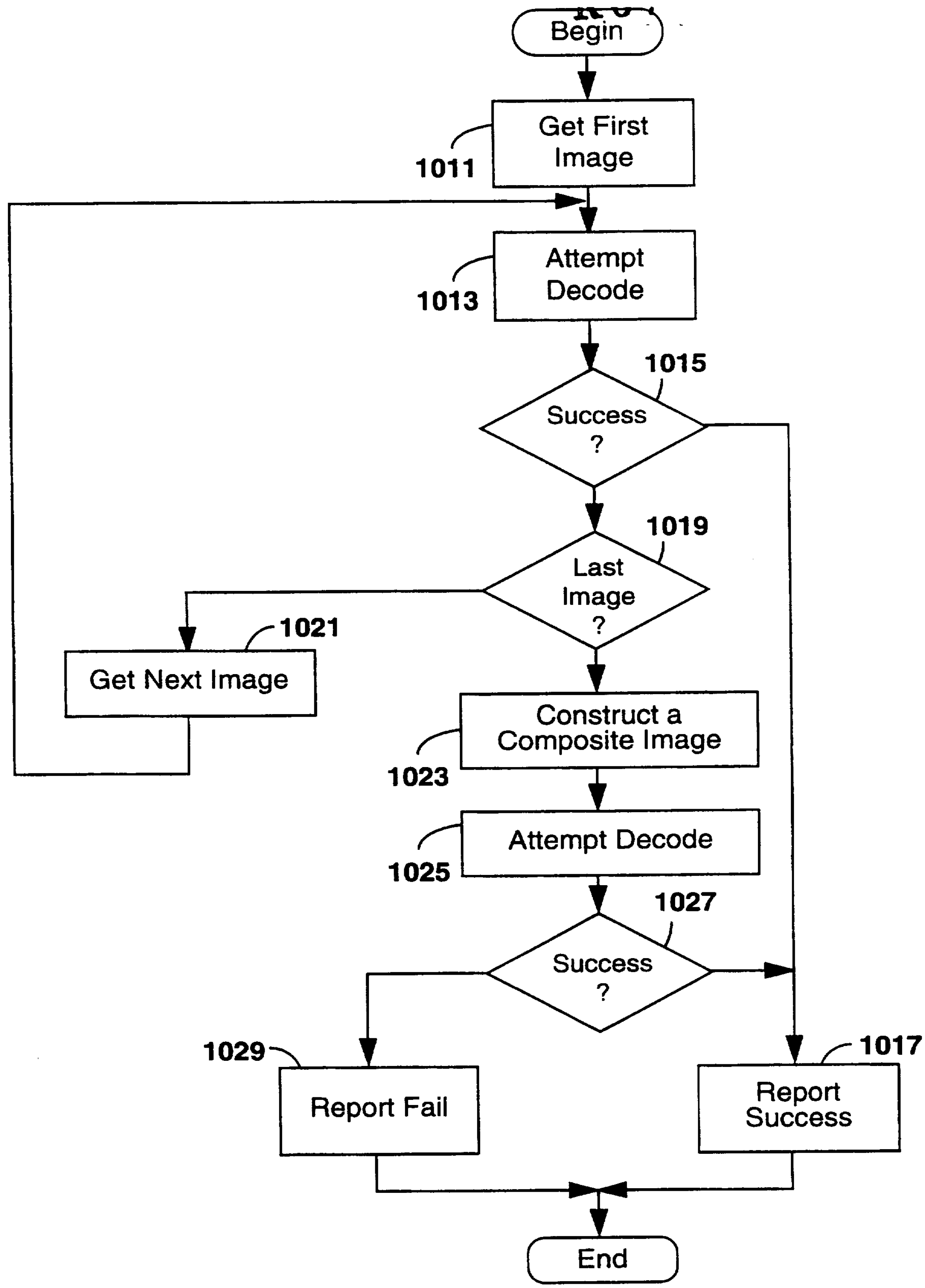

FIG. 10

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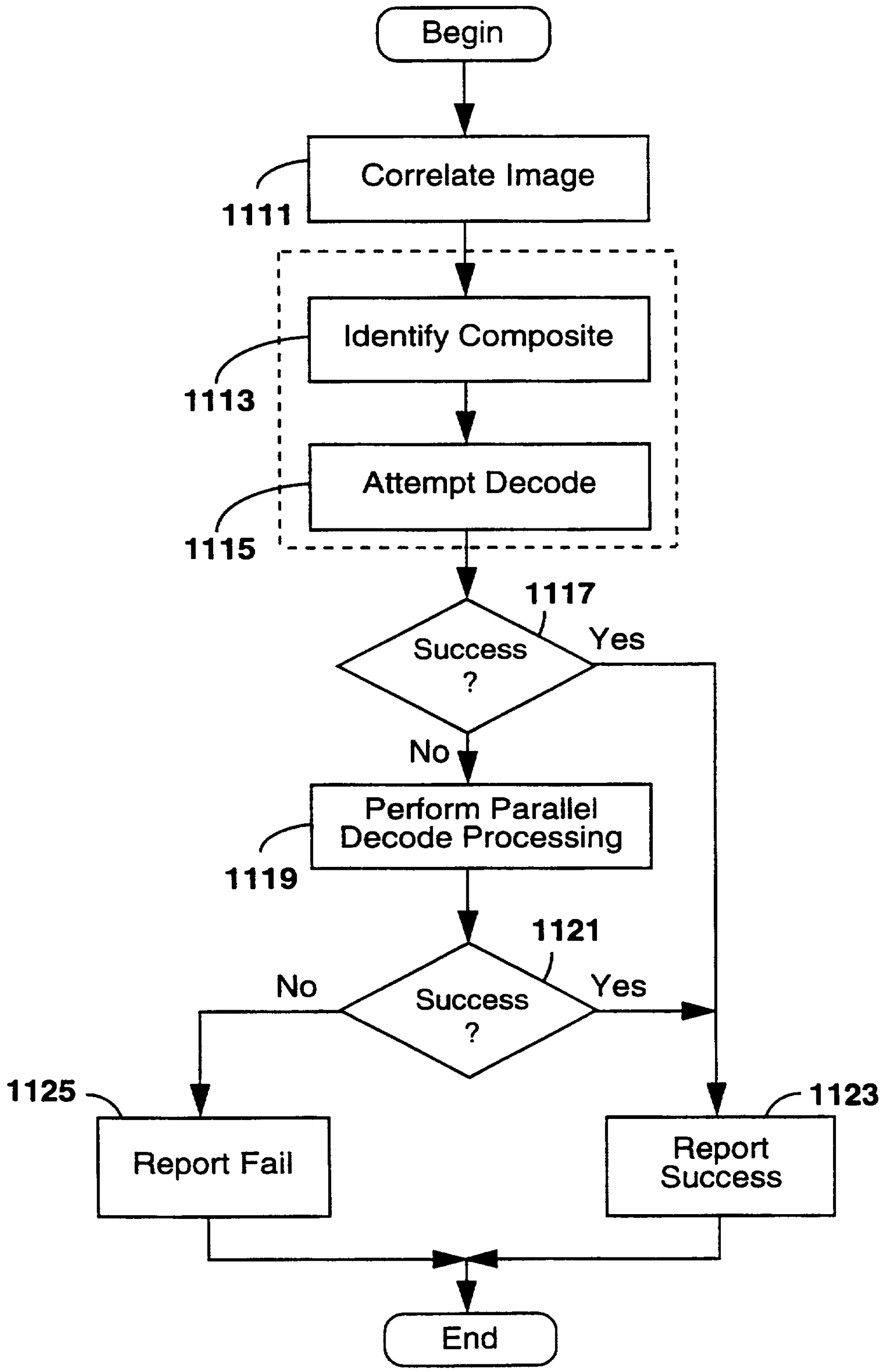

FIG. 11

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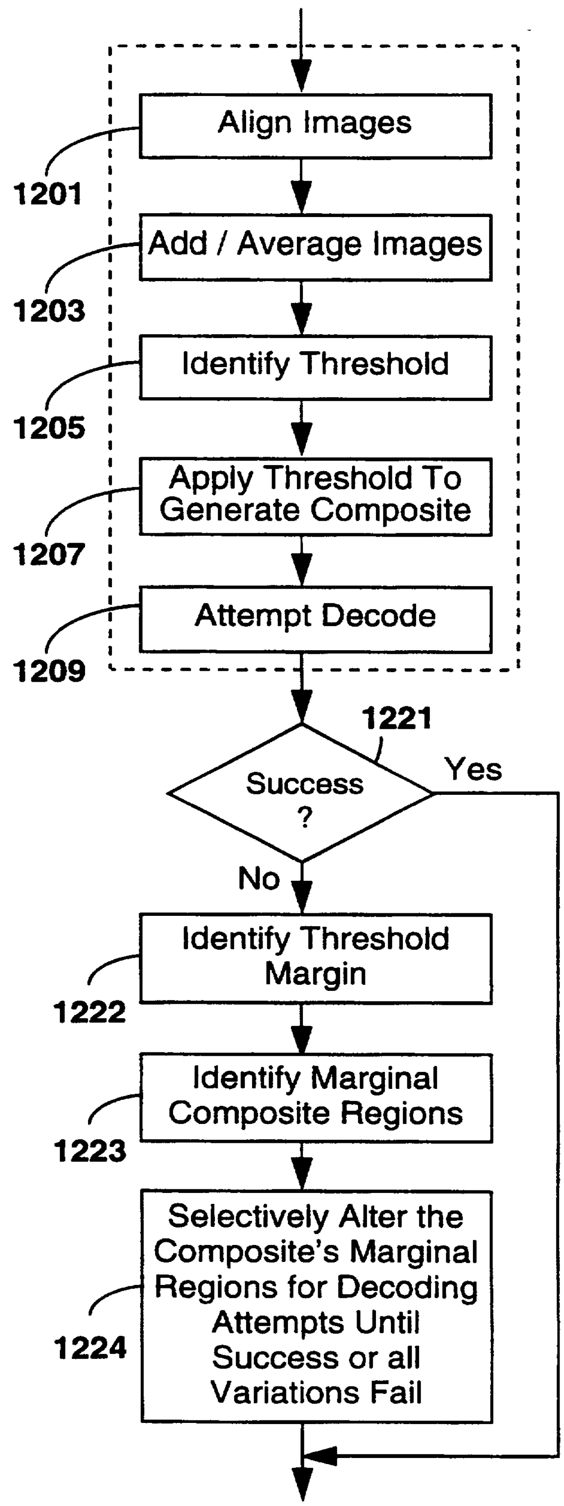

FIG. 12

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :GO6K 7/10
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Minimum documentation searched (classification system followed by classification symbols)
U.S. : 235/454,462,463

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US,A, 4,570,057 (CHADIMA JR. ET AL) 11 FEB 1986 (11/02/86) SEE ENTIRE DOCUMENT	1-10
Y	US,A, 5,124,538 (LAPINSKI ET AL) 23 JUNE 1992 (23/06/92),SEE ENTIRE DOCUMENT	1-10
Y	US,A, 5,278,398 (PAVLIDIS ET AL) 11 JAN, 1994 (11/01/94), SEE ENTIRE DOCUMENT	1-10
Y	US,A, 5,493,108 (CHERRY ET AL) 20 FEB, 1996 (20/02/96), SEE ENTIRE DOCUMENT	1-10

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 SEPTEMBER 1997	22.10.97

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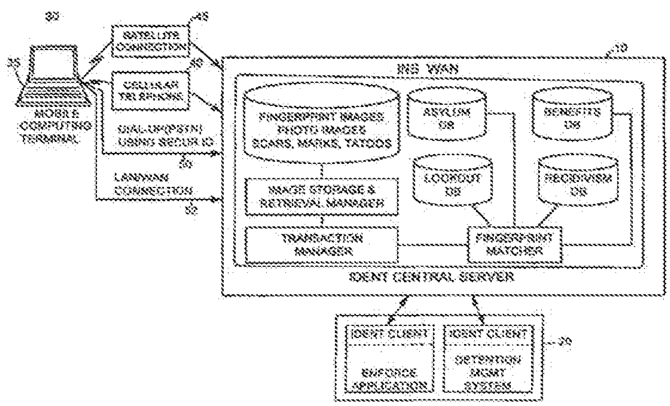

(57) **Abstract**

A distributed biometric identification system incorporates highly mobile workstations. The system generally includes a plurality of mobile workstations and a file server remotely located from the workstations. The workstations receive input biometric data, such as fingerprint and photographic data, and couples that biometric data to the remote file server. The file server compares the input biometric data with stored biometric data to determine whether any of the stored biometric data matches the input biometric data. The results of the comparison are provided to the workstation that requested the comparison. Workstation mobility is enhanced by providing a wireless and/or PSTN communications link between the workstation and the remotely located file server. Workstation mobility is further improved by housing the workstation in a self-contained, compartmentalized carrying case. Workstation mobility may be even further enhanced by housing the workstation in a so-called lunchbox configuration having a main body, a front panel hinged to the main body, and a back panel hinged to the main body. The front and back panels each have a stowed position adjacent the main body, and a deployed position away from the main body. When the panels are in their stowed positions, the workstation (*i.e.*, main body, front panel, and back panel) is a compact, portable unit.

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MOBILE BIOMETRIC IDENTIFICATION SYSTEM

TECHNICAL FIELD OF THE INVENTION

The present invention relates generally to identification systems. More particularly, it relates to a method and apparatus for identifying individuals based on biometric information such as fingerprints and photographs.

BACKGROUND OF THE INVENTION

In the past, identification of individuals that are processed by the Immigration and Naturalization Service (INS) or other governmental agencies, for example, has been a relatively slow process. Although many governmental agencies maintain large databases containing fingerprints, photographic information and other relevant data pertaining to individuals that use the services of the respective agencies, no known system has been able to quickly search and retrieve information relating to identification and interaction with these individuals. For example, the INS interacts with and is required to identify millions of persons each year, including immigration law violators, immigration benefit applicants, individuals requesting asylum, travelers, and visitors to the United States. Many encounters are processed under severe time constraints and with insufficient access to relevant information.

A co-pending, commonly owned patent application, serial no. 08/857,112 filed on May 15, 1997 addresses this problem by providing a distributed biometric identification system and architecture for rapidly identifying individuals using fingerprint and photographic data. The disclosed architecture includes a centralized INS server, a plurality of distributed client workstations that are remotely located from the centralized server, and a wide area telecommunications network interconnecting the client workstations to the server. The centralized server includes a transaction management subsystem, a database for storing fingerprint minutiae of individuals that are of interest to users of the system, a matching controller subsystem coupled between the transaction management subsystem and the database for matching fingerprints of individuals to fingerprints stored in the database, and an image storage and retrieval subsystem for storing and retrieving electronic images of fingerprints and photographic images of individuals.

The above-described system is highly effective in allowing a large number of remotely located users to access, search, compare and retrieve various types of biometric identifying data/information. The present invention is directed to an improvement wherein user location options, user mobility, and overall user access to the distributed biometric system is even further enhanced.

SUMMARY OF THE INVENTION

The present invention may be embodied in a distributed biometric identification system having highly mobile user workstations. More particularly, the invention may be embodied in a distributed, mobile biometric identification system and architecture for rapidly identifying individuals using fingerprint and photographic data. The disclosed architecture includes a centralized server, and a plurality of distributed, mobile client workstations that are remotely located from the centralized server. The mobile workstation includes a substantially portable two-way communications link (e.g., a land-based or satellite-based mobile radiotelephone) that may be used to place the mobile workstation in communication with the centralized server. The centralized server includes a transaction management subsystem, a database for storing fingerprint minutiae of individuals that are of interest to users of the system, a matching controller subsystem coupled between the transaction management subsystem and the database for matching fingerprints of individuals to fingerprints stored in the database, and an image storage and retrieval subsystem for storing and retrieving electronic images of fingerprints and photographic images of individuals.

The above-described mobile workstation is preferably embodied in a substantially portable computing environment having, for example, a portable computer, a portable camera coupled to the computer, a portable fingerprint scanner coupled to the computer, and a substantially portable two-way communications link (e.g., modem) coupled to the computer. Preferably, the communications link includes a land-based or satellite-based mobile radiotelephone.

In one embodiment of the present invention, the portable computer includes a so-called "notebook" or "laptop" computer having for example 32MB of RAM, an AC power supply, and an AC power cable. Additionally, the portable computer is outfitted with an MRT VideoPort PC card and a Megahertz 33.6 modem/ethernet card. The MRT VideoPort PC card serves as the interface between the portable computer hardware and the fingerprint scanner and the color camera. An MRT video cable is also provided to connect the MRT VideoPort PC card to the fingerprint scanner and the color camera. The Megahertz 33.6 modem/ethernet card provides the portable computer the ability to network to the INS server from local and remote sites. Specifically, networking from local sites can be accomplished through the ethernet functionality of the card. Remote networking can be accomplished through the use of the 33.6 baud modem functionality of the card. Additionally, the required network and telephone cables are also used in the configuration. The portable computer may be configured with Windows 95 operating system software, for example. The portable computer may be further configured with a user-friendly and intuitive graphical user interface using, for example, Microsoft Visual C++ software, and a structured language (SQL) based, client server, front end query tool. The SQL software is an off the shelf product from Oracle®. The SQL software is the foundation of the Oracle® level of communication within the system. That is, when the system user enters a query the Oracle® component that accepts the query needs to be able to communicate the query over the network to another Oracle® component. The SQL language performs the operation of enabling the query communication between Oracle® components. The portable computer's screen displays menu-driven screens from which users may select specific functions (such as search and enroll, search only, and verify functions) that are to be performed by the system.

In another embodiment of the present invention, the laptop computer, camera, fingerprint scanner and modem are electronically coupled together and conveniently housed in a carrying case. For example, a two-piece, hinged rugged construction carrying case may be outfitted with a foam template having cutouts for holding in place the various components, a power strip for accepting the power cord connections of the various components and providing 12 volt AC power thereto, and a 12 volt DC invertor having a 12 volt extension cord for coupling the strip to an alternative power source, for example, a cigarette lighter of an automobile. The power strip preferably includes surge suppressor circuitry to protect the various components from damage due to power surges.

In still another embodiment of the invention, the above-described portable computer may be housed in a portable, substantially rectangular, self-contained unit known generally as a "lunchbox" CPU. The lunchbox, according to the present invention, includes a main body, a front panel and a back panel. The front and back panels are hinged to the main body such that each may be folded up to a stowed position against the main body, or folded down to a deployed position against the main body. In general, the main body houses the main computing boards and a display screen, the front panel houses a keyboard, and the back panel houses the camera, the fingerprint scanner and the modem. When in their stowed positions, the front and back panels and the main body combine to form the portable lunchbox. When the front panel is deployed, it exposes the keyboard and the display screen on the main body. When the back panel is deployed, it exposes the camera, fingerprint scanner and modem.

The following describes the procedures that can be followed when using the above-described system in connection with immigration services. When an individual is identified as an undocumented alien, he/she is taken to a mobile workstation. The workstation operator chooses the "search and enroll" feature. The initiation of "search and enroll" brings up a screen that prompts the operator to first place the individual's left index finger on the fingerprint scanner. The screen then prompts the operator to place the individual's right index finger on the fingerprint scanner. Quality analysis is performed on the scanned fingerprint data to make sure that the fingerprint image is of sufficient quality. The screen then turns on the camera and prompts the user to snap a photograph of the individual.

After the picture is taken, the operator is returned to the entry screen for entry of non-biometric data (referred to herein as "biodata"). The user then enters the alien's name, birth date, age and any other information that can be obtained. The workstation associates all entered "biodata" with the current biometric data and with the current request. Upon completion of the biodata screen, a submit button is pressed. The submit button initiates sending the data via modem to the file server located at a remote processing center. A key feature of the invention is that the data is transmitted to the processing center over a widely available communications link such as the public switched telephone network (PSTN), land-based radiotelephone infrastructure, or satellite-based communications.

The processing center takes over and starts processing the input data, freeing the workstation to being enrolling another individual. A status indicator on the bottom of the workstation screen indicates the status of a particular transaction. The data processing center searches a number of databases, each of which has its own meaning. The databases are referred to generally as "lookout," "recidivists," "asylum," and "benefits." The lookout database contains information on individuals with criminal records on file with the Immigration and Naturalization Services, or who are considered to be "lookouts" posing potential threats to the health and safety of border patrol personnel. The recidivists database contains information on individuals who have attempted to enter the U.S. illegally on multiple occasions. The asylum database contains information on individuals encountered during an asylum application process. The asylum information is checked to detect and reduce immigration fraud. The benefit database is used to verify the identity of individuals encountered during the benefit servicing process to approve or deny applications or petitions for immigration benefits.

The data processing center reports to the workstation the number of hits, if any. The workstation may then call up the biometric data and/or the biodata for each hit in order to review it and make a determination of whether the "hit" is the individual in question.

The present invention may be embodied in a mobile workstation for use in connection with a distributed biometric identification system, said workstation comprising: a portable computer; a biometric data input system coupled to said portable computer; a portable communications terminal coupled to said portable computer; said communications terminal capable of initiating the establishment of a communication link between said workstation and a file server remotely located from said workstation, at least a portion of said communications link comprising a wireless communications link; said biometric data input system capable of receiving input biometric information and providing said input biometric information to said computer; said computer programmed to control said portable communications terminal to begin said initiation of said communication link between said workstation and said file server, and transmit said input biometric information over said communication link to said remote file server.

The present invention may also be embodied in a mobile workstation for use in connection with a distributed biometric identification system, said workstation comprising: a portable computer; a biometric data input system coupled to said portable computer; a portable communications terminal coupled to said portable computer; said communications terminal capable of initiating the establishment of a communication link between said workstation and a file server remotely located from said workstation, at least a portion of said communications link comprising a public switched telephone network (PSTN); said biometric data input system capable of receiving input biometric information and providing said input biometric information to said computer; said computer programmed to control said portable communications terminal to begin said initiation of said communication link between said workstation and said file server, and transmit said input biometric information over said communication link to said remote file server.

In an alternative embodiment of the above-described combination, the portable communications terminal comprises a telephone dialing apparatus; and said initiating comprises dialing a telephone number to establish a telephone line connection with said remotely located file server over said PSTN.

The present invention may be further embodied in a mobile workstation for use in connection with a distributed biometric identification system, said workstation comprising: a portable computer; a fingerprint scanner coupled to said portable computer; a camera coupled to said portable computer; a portable communications terminal coupled to said portable computer; said communications terminal capable of initiating the establishment of a communication link between said workstation and a file server remotely located from said workstation, at least a portion of said communications link comprising a wireless communications link; said fingerprint scanner capable of receiving input fingerprint information and providing said input fingerprint information to said computer; said camera capable of receiving input photographic information and providing said input photographic information to said computer; said computer programmed to control said portable communications terminal to begin said initiation of said communication link between said workstation and said file server, and transmit said input biometric information over said communication link to said remote file server; said computer further programmed to receive from said file server over said communication link stored fingerprint and photographic information stored at said file server that matches said input fingerprint and photographic data transmitted from said workstation to said file server; said computer further programmed to receive from said file server over said communication link information indicating that no stored fingerprint or photographic information at said file server matches said input fingerprint or photographic data transmitted from said workstation to said file server.

The present invention may further be embodied in a mobile workstation for use in connection with a distributed biometric identification system, said workstation comprising: a portable carrying case containing a portable computer, a biometric data input system coupled to said portable computer, a portable communications terminal coupled to said portable computer, and a power strip for coupling power to said computer, biometric data input system, and communications terminal; said communications terminal capable of initiating the establishment of a communication link between said workstation and a file server remotely located from said workstation, at least a portion of said communications link comprising a wireless communications link; said biometric data input system capable of receiving input biometric information and providing said input biometric information to said computer; said computer programmed to control said portable communications terminal to begin said initiation of said communication link between said workstation and said file server, and transmit said input biometric information over said communication link to said remote file server.

The present invention may also be embodied in a method of coupling biometric data to a file server for use in connection with a distributed biometric identification system, the steps comprising: gathering input biometric data at a first location; initiating the establishment of a communication link between said first location and a file server remotely located from said first location, at least a portion of said communications link comprising a wireless communications link; and transmitting said input biometric information over said communication link to said remote file server.

In an alternative embodiment of the present invention, the above described method further comprises the step of receiving at said first location over said communication link stored biometric information that matches said input biometric data transmitted from said first location to said file server.

In another alternative embodiment of the present invention, the above described method further comprises the step of receiving at said first location over said communication link information indicating that no stored biometric information at said file server matches said input biometric data transmitted from said first location to said file server.

In still another alternative embodiment of the present invention, the above described method further comprises said initiating step comprising dialing a telephone number to establish a telephone line connection with said remotely located file server.

The present invention may also be embodied in a mobile workstation for use in connection with a distributed biometric identification system, said workstation comprising: a portable computer having a main body, a front panel hinged to said main body, and a back panel hinged to said main body; said front panel having a stowed position adjacent said main body and a deployed position away from said main body; said back panel having a stowed position adjacent said main body and a deployed position away from said main body; a biometric data input system coupled to said portable computer and at least partially housed in said back panel; a portable communications terminal coupled to said portable computer and at least partially housed in said back panel; said communications terminal capable of initiating the establishment of a communication link between said workstation and a file server remotely located from said workstation, at least a portion of said communications link comprising a wireless communications link; said biometric data input system capable of receiving input biometric information and providing said input biometric information to said computer; said computer programmed to control said portable communications terminal to begin said initiation of said communication link between said workstation and said file server, and transmit said input biometric information over said communication link to said remote file server.

The invention itself, together with further objects and attendant advantages, will best be understood by reference to the following detailed description, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a diagram of a distributed biometric identification system having mobile distributed workstations embodying the present invention.

FIGURE 2 is a hardware-based diagram of the mobile distributed workstation shown in FIGURE 1, wherein the portable computer of the mobile workstation includes a laptop or notebook computer.

FIGURE 3 is a more detailed diagram of the mobile workstation shown in FIGURE 2, wherein the workstation incorporated a portable case.

FIGURE 4 is a hardware-based diagram of the mobile distributed workstation shown in FIGURE 1, wherein the mobile workstation is housed in a lunchbox configuration.

FIGURES 5 and 6 further illustrate the lunchbox configuration shown in FIGURE 4.

FIGURE 7 is a diagram illustrating the software operations that perform the biometric identification functions of the portable computers shown in FIGURES 1-6.

DETAILED DESCRIPTION OF THE INVENTION

By way of introduction, a general description of the invention and the disclosed embodiments thereof will now be provided. The present invention may be embodied in a distributed biometric identification system having highly mobile user workstations. More particularly, the invention may be embodied in a distributed, mobile biometric identification system and architecture for rapidly identifying individuals using fingerprint and photographic data. The disclosed architecture includes a centralized server, and a plurality of distributed, mobile client workstations that are remotely located from the centralized server. The mobile workstation includes a substantially portable two-way communications link (e.g., a long-based or satellite-based mobile radiotelephone) that may be used to place the mobile workstation in communication with the centralized server. The centralized server includes a transaction management subsystem, a database for storing fingerprint minutiae of individuals that are of interest to users of the system, a matching controller subsystem coupled between the transaction management subsystem and the database for matching fingerprints of individuals to fingerprints stored in the database, and an image storage and retrieval subsystem for storing and retrieving electronic images of fingerprints and photographic images of individuals.

The above-described mobile workstation is preferably embodied in a substantially portable computing environment having, for example, a portable computer, a portable camera coupled to the computer, a portable fingerprint scanner coupled to the computer, and a substantially portable two-way communications link (e.g., modem) coupled to the computer. Preferably, the communications link includes a land-based or satellite-based mobile radiotelephone.

In one embodiment of the present invention, the portable computer includes a so-called "notebook" or "laptop" computer having for example 32MB of RAM ,and AC power supply, and an AC power cable. Additionally, the portable computer is outfitted with an MRT VideoPort PC card and a Megahertz 33.6 modem/ethernet card. The MRT VideoPort PC card serves as the interface between the portable computer hardware and the fingerprint scanner and the color camera. An MRT video cable is also provided to connect the MRT VideoPort PC card to the fingerprint scanner and the color camera. The Megahertz 33.6 modem/ethernet card provides the portable computer the ability to network to the INS server from local and remote sites. Specifically, networking from local sites can be accomplished through the ethernet functionality of the card. Remote networking can be accomplished through the use of the 33.6 baud modem functionality of the card. Additionally, the required network and telephone cables are also used in the configuration. The portable computer may be configured with Windows 95 operating system software, for example. The portable computer may be further configured with a user-friendly and intuitive graphical user interface using, for example, Microsoft Visual C++ software, and a structured language (SQL) based, client-server, front end query tool. The SQL software is an off the shelf product from Oracle®. The SQL software is the foundation of the Oracle® level of communication within the system. That is, when the system user enters a query the Oracle® component that accepts the query needs to be able to communicate the query over the network to another Oracle® component. The SQL language performs the operation of enabling the query communication between Oracle® components. The portable computer's screen displays menu-driven screens from which users may select specific functions (such as search and enroll, search only, and verify functions) that are to be performed by the system.

In another embodiment of the present invention, the laptop computer, camera, fingerprint scanner and modem are electronically coupled together and conveniently housed in a carrying case. For example, a two-piece, hinged rugged construction carrying case may be outfitted with a foam template having cutouts for holding in place the various components, a power strip for accepting the power cord connections of the various components and providing 12 volt AC power thereto, and a 12 volt DC invertor having a 12 volt extension cord for coupling the strip to an alternative power source, for example, a cigarette lighter of an automobile. The power strip preferably includes surge suppressor circuitry to protect the various components from damage due to power surges.

In still another embodiment of the invention, the above-described portable computer may be housed in a portable, substantially rectangular, self contained unit known generally as a "lunchbox" CPU. The lunchbox, according to the present invention, includes a main body, a front panel and a back panel. The front and back panels are hinged to the main body such that each may be folded up to a stowed position against the main body, or folded down to a deployed position away from the main body. In general, the main body houses the main computing boards and a display screen, the front panel houses a keyboard, and the back panel houses the camera, the fingerprint scanner and the modem. When in their stowed positions, the front and back panels and the main body combine to form the portable lunchbox. When the front panel is deployed, it exposes the keyboard and the display screen on the main body. When the back panel is deployed, it exposes the camera, fingerprint scanner and modem.

The following describes the procedures that can be followed when using the above-described system in connection with immigration services. When an individual is identified as an undocumented alien he/she is taken to a mobile workstation. The workstation operator chooses the "search and enroll" feature. The initiation of "search and enroll" brings up a screen that prompts the operator to first place the individual's left index finger on the fingerprint scanner. The screen then prompts the operator to place the individual's right index finger on the fingerprint scanner. Quality analysis is performed on the scanned fingerprint data to make sure that the fingerprint image is of sufficient quality. The screen then turns on the camera and prompts the user to snap a photograph of the individual.

After the picture is taken, the operator is returned to the entry screen for entry of non-biometric data (referred to herein as"biodata"). The user then enters the alien's name, birth date, age and any other information that can be obtained. The workstation associates all entered "biodata" with the current biometric data and with the current request. Upon completion of the biodata screen, a submit button is pressed. The submit button initiates sending the data via modem to the file server located at a remote processing center. A key feature of the invention is that the data is transmitted to the processing center over a widely available communications link such as the public switched telephone network (PSTN), land-based radiotelephone infrastructure, or satellite-based communications.

The processing center takes over and starts processing the input data, freeing the workstation to begin enrolling another individual. A status indicator on the bottom of the workstation screen indicates the status of a particular transaction. The data processing center searches a number of databases, each of which has its own meaning. The databases are referred to generally as "lookout," "recidivists," "asylum," and "benefits." The lookout database contains information on individuals with criminal records on file with the Immigration and Naturalization Services, or who are considered to be "lookouts" posing potential threats to the health and safety of border patrol personnel. The recidivists database contains information on individuals who have attempted to enter the U.S. illegally on multiple occasions. The asylum database contains information on individuals encountered during an asylum application process. The asylum information is checked to detect and reduce immigration fraud. The benefit database is used to verify the identity of individuals encountered during the benefit servicing process to approve or deny applications or petitions for immigration benefits.

The data processing center reports to the workstation the number of hits, if any. The workstation may then call up the biometric data and/or the biodata for each hit in order to review it and make a determination of whether the "hit" is the individual in question.

Referring now to FIGURE 1, a diagram of a system employing the present invention is shown. The system generally includes a central server 10, a set of software clients 20, and a mobile access station 30.

The central server 10 provides backend functionality for the system. The central server 10 provides a variety of functions including receiving input fingerprint images and photo images, image storage and retrieval management, transaction management, and fingerprint matching functionality, along with databases including "asylum," "lookout," "benefits," and "recidivism." These functions are available for use by the user at a mobile access station 30. Database functions may include but are not limited to the storage and retrieval of biodata such as fingerprints, biographical history, and photographs. The database may also contain information as to whether an individual is dangerous, a repeat immigration offender, or eligible for asylum and benefits.

The lookout database contains information on individuals with criminal records on file with the Immigration and Naturalization Services, or who are considered to be "lookouts" posing potential threats to the health and safety of border patrol personnel. The recidivists database contains information on individuals who have attempted to enter the U.S. illegally on multiple occasions. The asylum database contains individuals encountered during an asylum application process. The asylum information is checked to detect and reduce immigration fraud. The benefit database is used to verify the identity of individuals encountered during the benefit servicing process to approve or deny applications or petitions for immigration benefits.

The central server 10 also has access to software clients 20. These software clients 20 allow the system user to begin processing paperwork regarding an apprehended individual before returning to an office to complete processing of the individual. The software clients 20 are accessed from mobile access stations 30 through the central server 10. Traditionally, paperwork on apprehended individuals has been typed on a typewriter and photocopied as necessary. The software clients 20 and the central server 10 allow the system user to enter relevant biodata from the apprehended individual into a database. The biodata may then be accessed and printed as needed by all authorized users of the central server 10. Software clients 20 may include detention facility information, such as the location of a prisoner within the prison system; and immigrant benefits and asylum information.

The mobile access station 30 shown in FIGURE 1 includes a mobile computing terminal 35, and remote access components such as a radiotelephone 40, a satellite connection 45, and a landline connection 50, as well as appropriate hardware for connecting to the above-noted remote access components and other input and output devices. Hardware for gaining remote access may include a modem or some other communication-type card that may be interfaced with the mobile computing terminal 35. Remote access components provide the system user a communication path between the mobile computing terminal 35 and the central server 10.

A more detailed illustration of the mobile access station 30 and its associated components are shown in FIGURE 2. As illustrated, the mobile access station 30 includes a mobile computing terminal 35, a radiotelephone 40, a satellite connection 45, a landline connection 50, a color camera 55, and a fingerprint scanner 60. The mobile computing terminal 35 may be embodied in a portable notebook/laptop computer operating on the Windows 95® environment. The mobile computing terminal 35 gains access to the central server 10 via one of four paths including: the radiotelephone 40, the satellite connection 45, the landline connection 50, or direct connection to the LAN/WAN 52. The use of radiotelephone 40 to establish communication preferably includes the use of a three-Watt cellular telephone known in the art as a "bag phone." The use of a bag radiotelephone provides a better data path to the remote access server 65 than a low power "hand-held" radiotelephone. When the mobile computing terminal 35 establishes communication to the central server 10, it does so through an access server 62. The access server 62 performs the function of verifying the identity of the entity who is attempting to gain access to the central server 10. In addition to the aforementioned communication devices, the mobile access station 30 includes a color camera 55 and a fingerprint scanner 60. The color camera 55 and a fingerprint scanner 60 are used to gather biometric data from the individual in question. The color camera 55 may be a digital camera or any other device suitable for obtaining digital images of apprehended individuals. The fingerprint scanner 60 is provided for obtaining digital images of the individual's fingerprints, digital fingerprint scanners are well known in the art. The color camera 55 and the fingerprint scanner 60 are interfaced to the mobile computing terminal 35 via a video capture card, which is known in the art.

In an alternative embodiment, a two-piece rugged construction case 65 (see FIGURE 3) may be used to house the mobile computing terminal 35, the radiotelephone 40, the color camera 55, and the fingerprint scanner 60. The portable case 65 provides component protection from shock and water damage. Additionally, the portable case 65 eliminates the need for field personnel to connect the various components of the mobile access station 30 together each time the system is to be used. Rather the portable case embodiment encases the connected hardware and creates one self contained unit providing a power connection by which to power the unit. The power connection may be a 120 VAC connection. Alternatively, a power connection may be adapted to receive 12 VDC input from an automobile cigarette lighter. The case may be outfitted with a foam template having cutouts for holding in place the various components, a power strip for accepting the power cord connections of the various components and providing 12 volt AC power thereto, and a 12 volt DC invertor having a 12 volt extension cord for coupling the strip to an alternative power source, for example, a cigarette lighter of an automobile. The power strip preferably includes surge suppressor circuitry to protect the various components from damage due to power surges.

FIGURE 4 illustrates another embodiment of the mobile access station 30 of the present invention. This alternate embodiment varies from the previous embodiment in that the mobile computing terminal is housed on an so-called "lunchbox" configuration 70. The lunchbox 70 is a self contained processing unit and carrying case. The processing unit and operating system of the lunchbox 70 are identical to that of the mobile computing terminal 35. The lunchbox 70 is capable of a accepting a number of different computer cards, which perform the function of interfacing to the radiotelephone 40, the color camera 55, the fingerprint scanner 60, the satellite connection 45, and the landline connection 50. Additionally, the lunchbox 70 configuration houses the radiotelephone 40, the color camera 55, and the fingerprint scanner 60 in a manner similar to the portable case 65.

The lunchbox 70 configuration offers the advantages of being lightweight, small, low cost, self-contained, and easy to maintain. Another distinct advantage is the addition of a bright screen that can be read in bright daylight, as opposed to a conventional laptop LCD screen that is difficult to read in bright sunshine. Similar to the portable case 65 configuration, the only external component to the lunchbox 70 is a power cord. Power may be provided either using 120 VAC or 12 VDC.

Side and plan views of the lunchbox 70 configuration can be seen in FIGURES 5 and 6. The lunchbox 70 configuration includes a main housing 75, a keyboard 80, a foldable front panel 85, a foldable back panel 90, a display screen 95, and a processing unit (not shown) and associated interface cards (not shown) for accessing the radiotelephone 40, the color camera 55, and the fingerprint scanner 60.

The front panel 85 folds down from an upright and locked position that covers the display screen 95 to a downward position which reveals the keyboard 80. Likewise, the back panel 90 folds down to permit user access to the radiotelephone 40, the color camera 55, and the fingerprint scanner 60. A major advantage to this particular feature is the fact that when both the front and back panels 85, 90 are closed and locked against the main housing 75 the keyboard 80, the display screen 95, and other associated components 40, 55, and 60 are protected from damage.

FIGURE 7 illustrates the software operations performed by the mobile workstation 30. As shown in FIGURE 7, the ident21m.exe file 100 is an executable file that is used on the mobile biometric identification system. The ident21m.exe file 100 is the file that controls the functions of the mobile terminal 30. The identi.ini file 110 holds initialization information that is used to initialize the ident21m.exe file 100, the mrtcap16.dll file 120, and imagemob.exe file 130. The ident.ini file 110 contains information pertaining to the hardware that is interfaced to the various software functions. For example, if a new fingerprint scanner is used, the ident.ini file 110 is the only file that must be changed to accommodate the hardware change.

The mrtcap16.dll file 120 performs the function of controlling video captures in the system. Specifically, the mrtcap16.dll file 120 controls the fingerprint scanner 60 and the color camera 55. After digital images are captured by the mrtcap16.dll file 120, they are passed to the imagemob.exe file 130, which performs the function of compressing and extracting digital images. The imagemob.exe file 130 makes software calls to a commercially available software package 140 known commercially under the tradename Cogent 140. The Cogent software 140 performs the processing of the images received by the imagemod.exe file 130.

The ident21m.exe file 100 is interfaced to a transaction manger 150 which is located at a remote site. The transaction manager 150 performs the function of receiving the image and biodata, as well as providing a software pathway from the ident21m.exe file 100 to the central server 10, which is also located at a remote site. Additionally, the ident21m.exe file 100 controls the on-screen display. On-screen display software 160 (available from Accusoft) is used to create various gray-scale on-screen displays. The Accusoft 160 software also provides various display utilities that aid in processing on-screen graphics. The i213.jpg file 170 is a graphics file that is printed when needed. Typically the i213.jpg file 170 is a form that is required when processing an apprehended individual.

When an individual is apprehended, the system user selects an icon from the on-screen display, which preferably represents a Windows 95 environment. The icons represent the method of interface to the central server 10. After the network connection is established, the system user is prompted to enter verification. Upon completion of verification, the system user may elect to enroll the apprehended individual into the database located at the central server 10. After selecting the enroll option, the ident.ini file 110 initializes all relevant files. As enrolment continues, the mrtcap16.dll file 120 performs the function of controlling the color camera and fingerprint scanner in a manner to obtain necessary information from the individual. The video images are compressed by the software 140 under the control of the imagemob.exe file 130. The information is then transferred to the transaction manager 150 via the ident21m.exe file 100 over the established communication link. The transaction manager 150 forwards the information to the central server 10. Queries as to the history of the apprehended individual are also forwarded to the central server 10 in a similar fashion. Information regarding the history of the individual is returned to the ident21m.exe file 100 via the ident transaction manager 150. The received information is transferred to the screen display using the on-screen display software 160.

The mobile workstation 30 described herein is preferably embodied in a substantially portable computing environment having, for example, a portable (e.g., a laptop or notebook) computer, a substantially portable camera coupled to the computer, a substantially portable fingerprint scanner coupled to the computer, and a substantially portable communications link coupled to the computer and preferably taking the form or a modem embodied in a land-based or satellite-based mobile radiotelephone.

The portable computer described herein preferably includes, for example, 32 MB of RAM, an AC power supply, and an AC power cable. Additionally, the portable computer is outfitted with an MRT VideoPort PC card and a Megahertz 33.6 modem/ethernet card. The MRT VideoPort PC card serves as the interface between the portable computer hardware and the fingerprint scanner and the color camera. An MRT video cable is also provided to connect the MRT VideoPort PC card to the fingerprint scanner and the color camera. The Megahertz 33.6 modem/ethernet card provides the portable computer the ability to network to the INS server from local and remote sites. Specifically, networking from local sites can be accomplished through the ethernet functionality of the card. Remote networking can be accomplished through the use of the 33.6 baud modem functionality of the card. Additionally, the required network and telephone cables are also used in the configuration. The portable computer may be configured with Windows 95 operating system software, for example. The portable computer may be further configured with a user-friendly and intuitive graphical user interface suing, for example, Microsoft Visual C++ software, and a structured language (SQL) based, client-server, front end query tool. The SQL software is an off the shelf product from Oracle®. The SQL software is the foundation of the Oracle® level of communication within the system. That is, when the system user enters a query the Oracle® component that accepts the query needs to be able to communication the query over the network to another Oracle® component. The SQL language performs the operation of enabling the query communication between Oracle® components. The portable computer's screen displays menu-driven screens from which users may select specific functions (such as search and enrol, search only, and verify functions) that are to be performed by the system.

Of course, it should be understood that a range of changes and modifications can be made to the preferred embodiment described above. For example, the present invention is described in connection with a particular hardware and processing structure for transmitting and receiving live biometric data. However, a wide variety of transmitting and receiving structures could be utilized as long as the essential mobile distributed workstation features described herein are present. It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting and that it be understood that it is the following claims, including all equivalents, which are intended to define the scope of this invention.