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**Yoshida et al.**

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(54) **IMAGE DISPLAY SYSTEM, IMAGE DISPLAY APPARATUS, IMAGE PROVIDING APPARATUS AND METHOD THEREOF**

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(52) **U.S. Cl.** ..... **348/333.01**; 345/589; 455/556.1

(58) **Field of Classification Search** ..... 348/333.01–333.02, 333.11–333.12, 348/211.99; 345/589–605; 382/168; 455/556.1, 455/550.1

See application file for complete search history.

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(Continued)

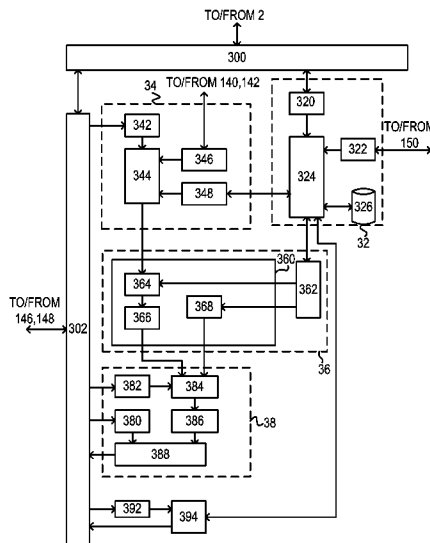
*Primary Examiner* — Tuan Ho

(74) *Attorney, Agent, or Firm* — Foley & Lardner LLP

(57) **ABSTRACT**

An image display apparatus disclosed in the present application is made up of a detection precision calculating module, a detecting module, and an image providing module. The detection precision calculating module calculates a detection precision that satisfies a designated restrictive condition. Based on the calculated detection precision, the detecting module detects a projection of a designated object from each image based on the calculated detection precision, and calculates the number of projections of the designated object included in each image. The image providing module arranges the respective pieces of image information according to the number of detected projections of the object and provides a list of arranged images as a search result.

**14 Claims, 19 Drawing Sheets**



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FIG. 1

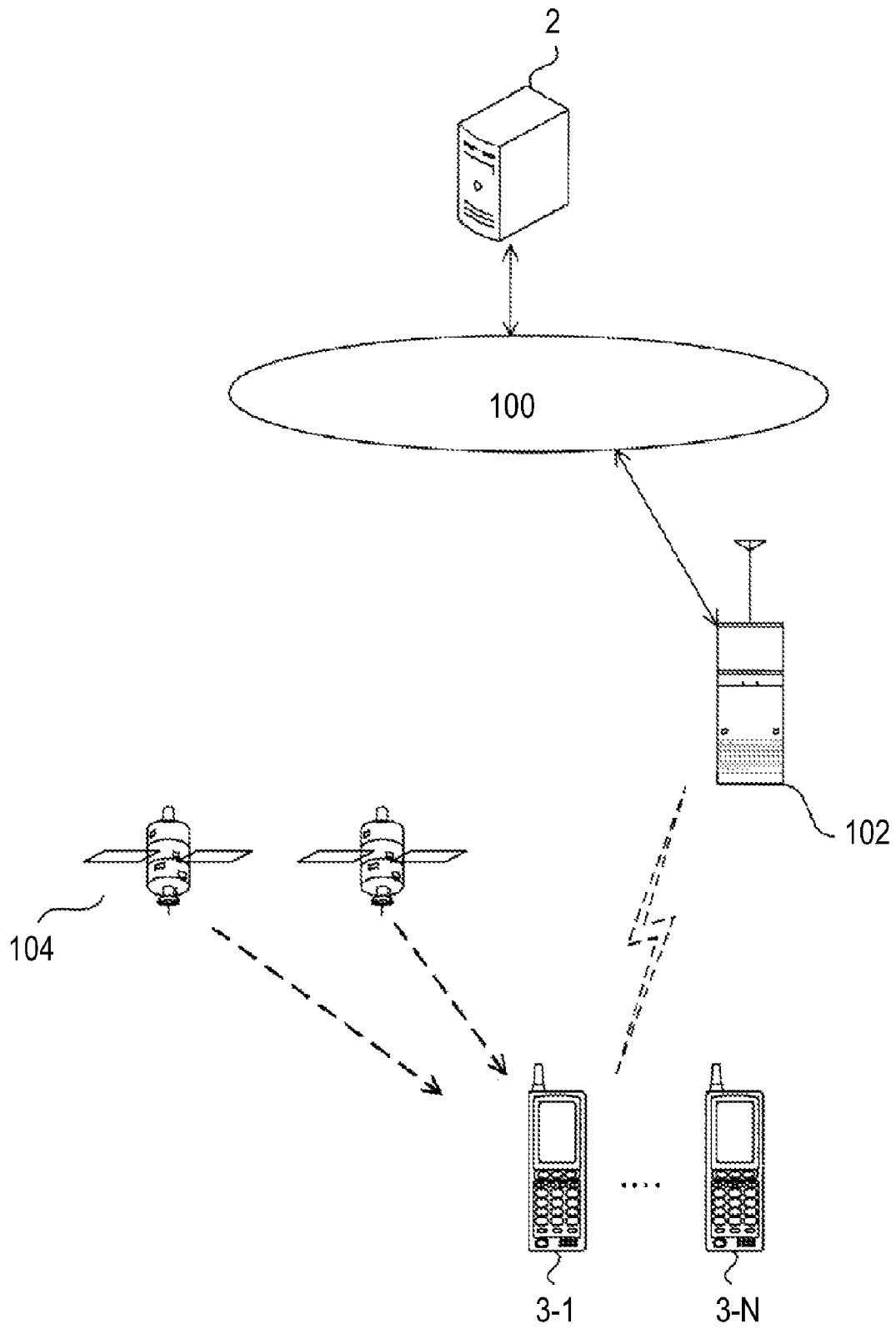
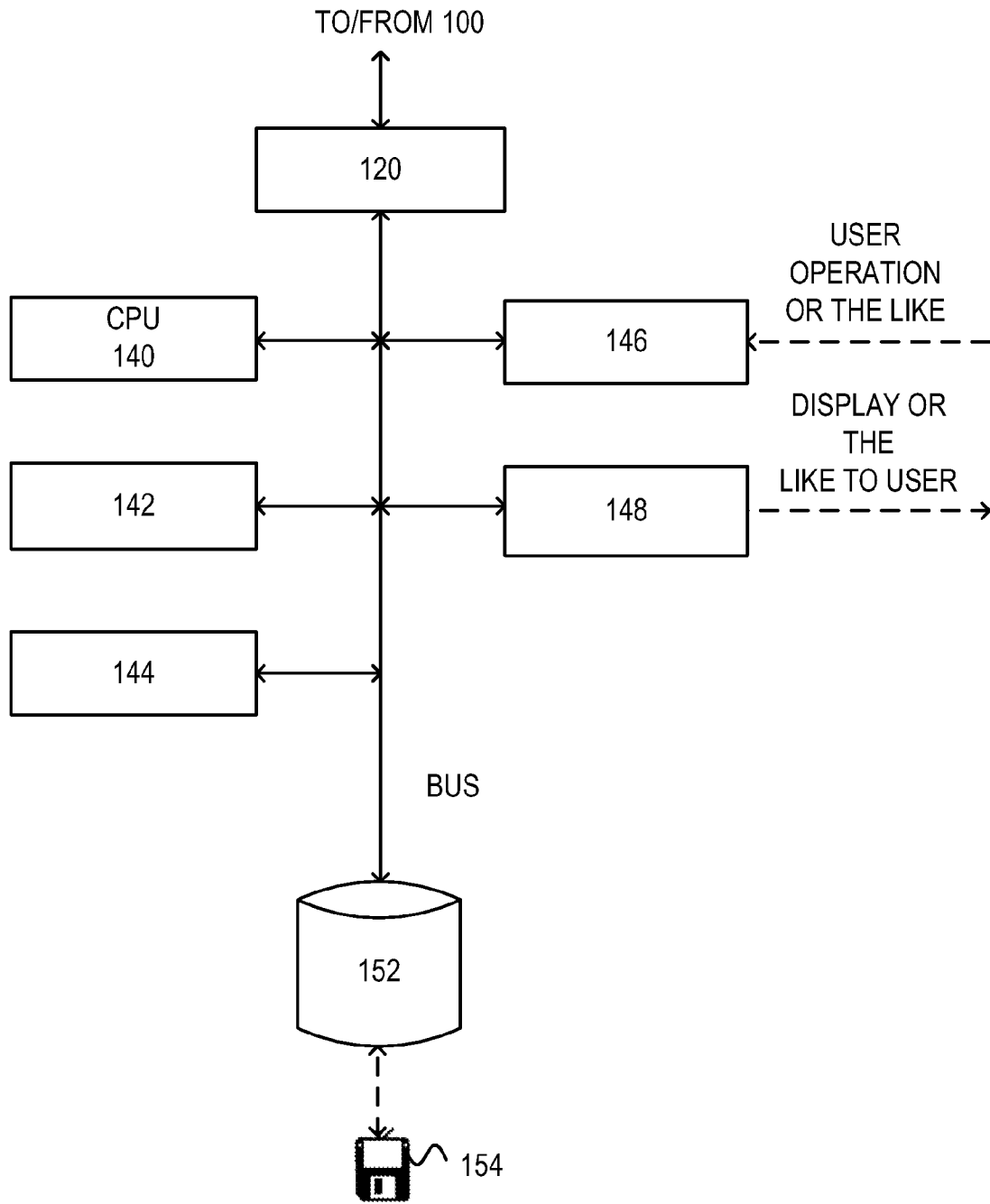


FIG. 2



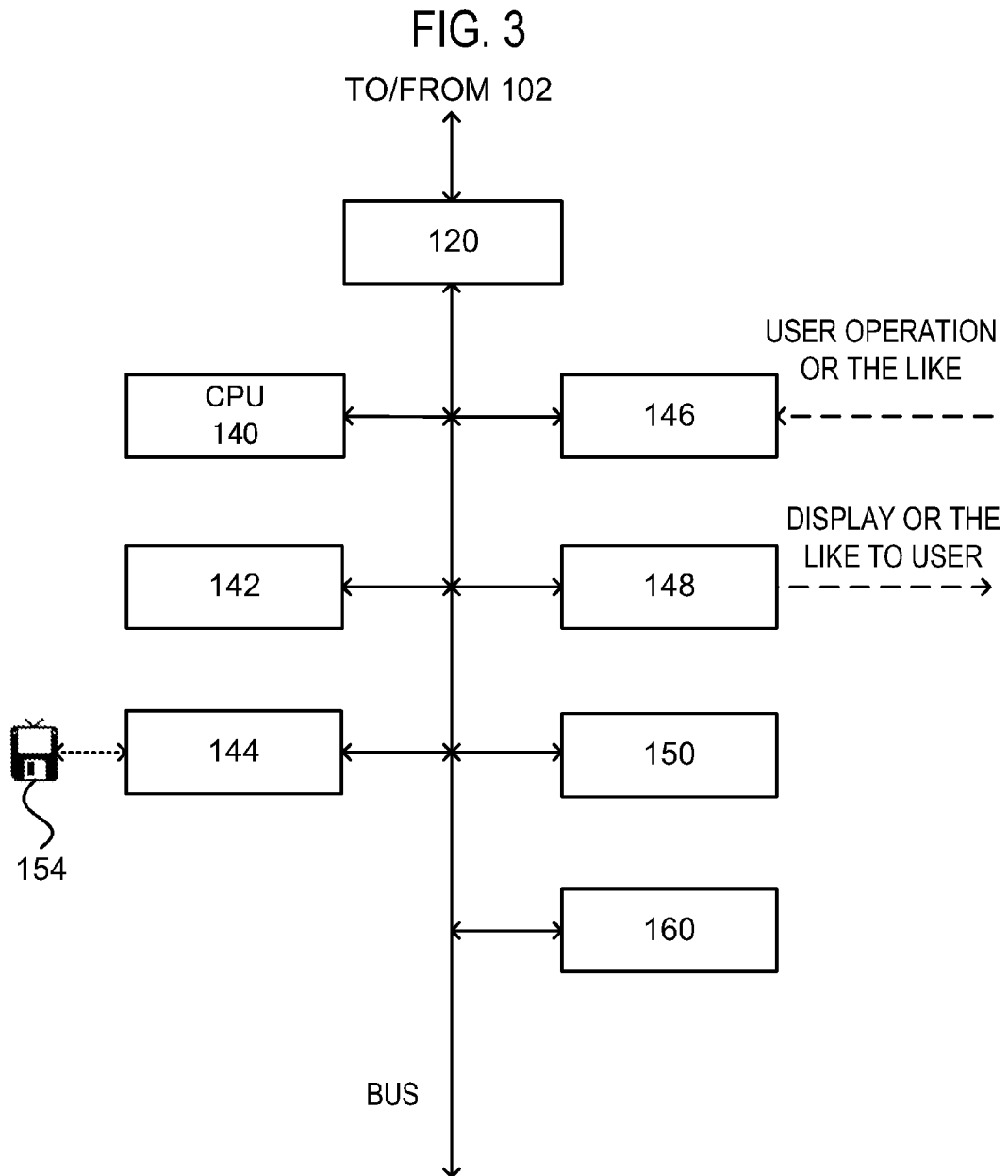


FIG. 4

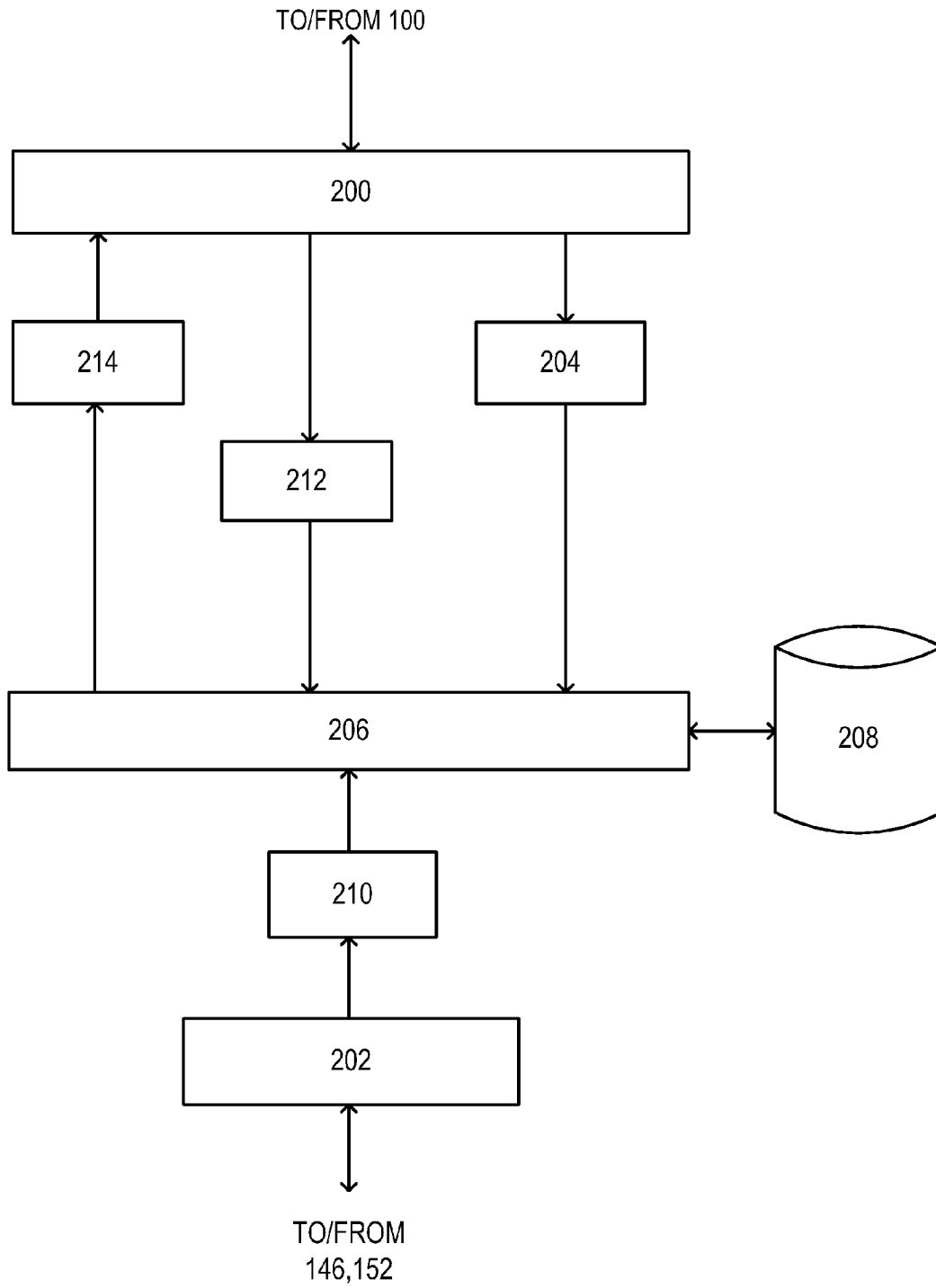


FIG. 5

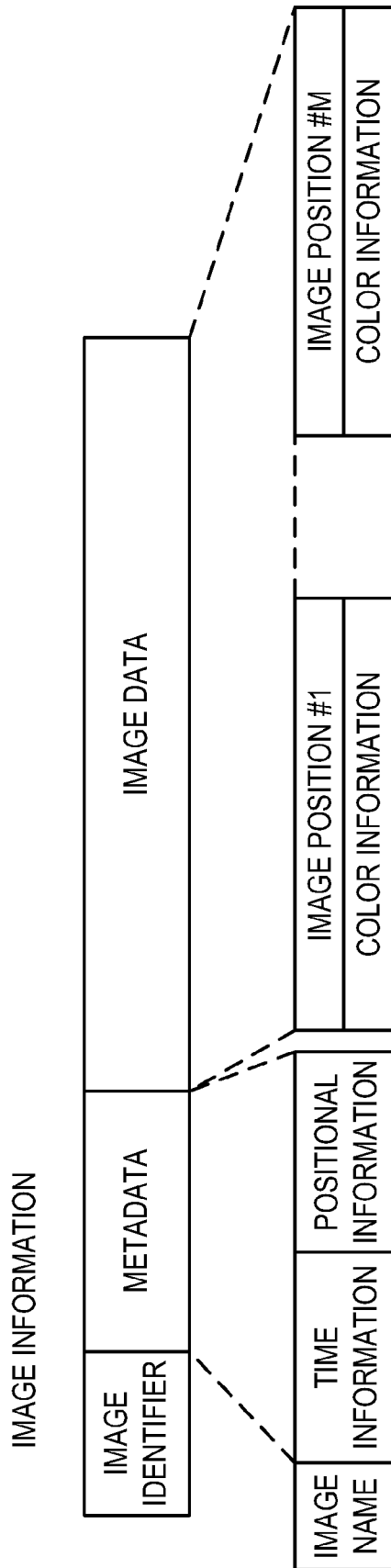


FIG. 6

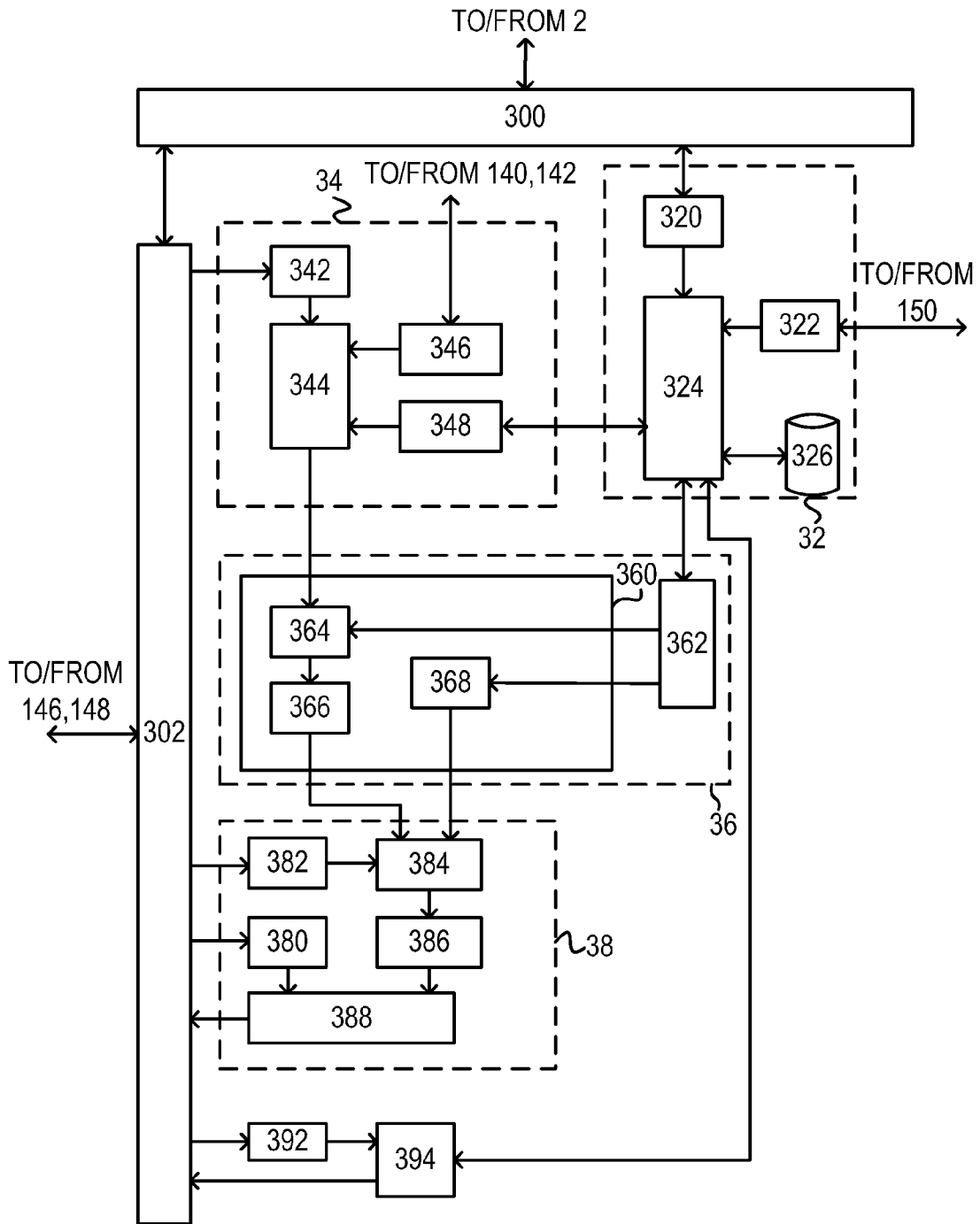




FIG. 7A

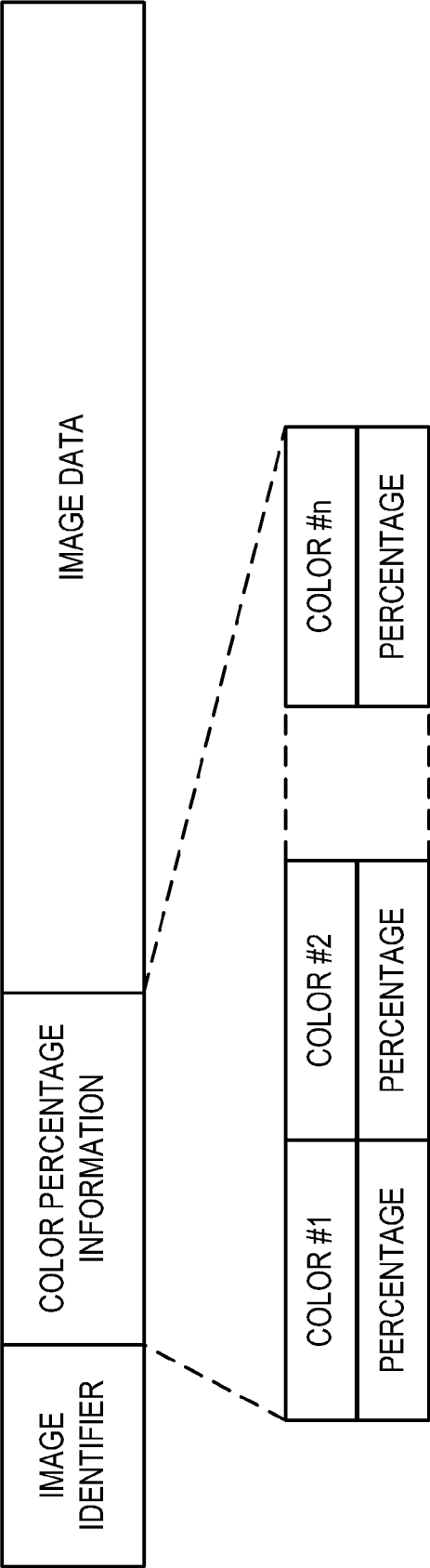


FIG. 7B

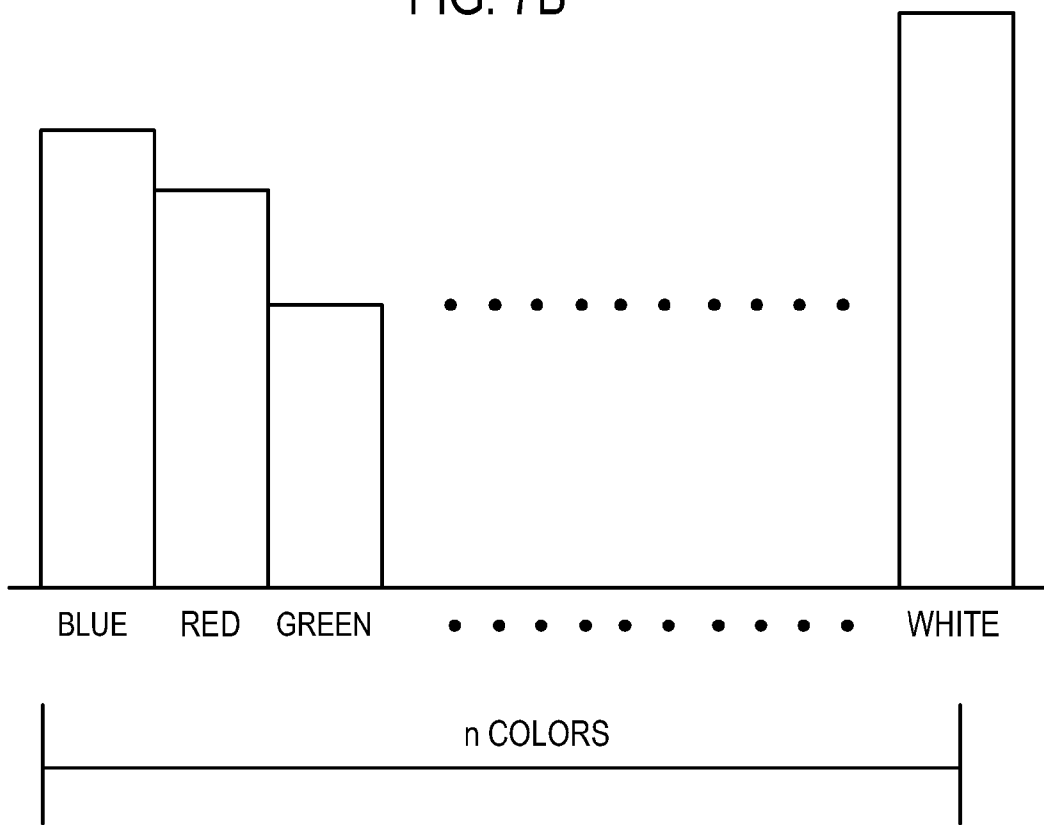


FIG. 8

IMAGE IDENTIFIER	COLOR DIFFERENCE AMOUNT	TIME DIFFERENCE AMOUNT	POSITIONAL DIFFERENCE AMOUNT	IMAGE DAT
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FIG. 9

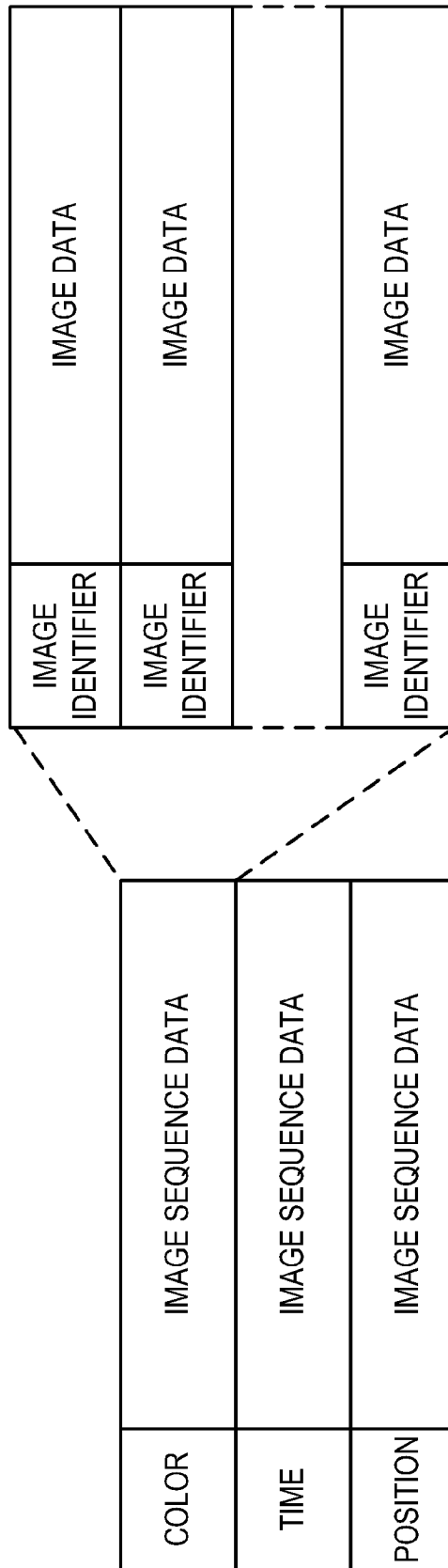
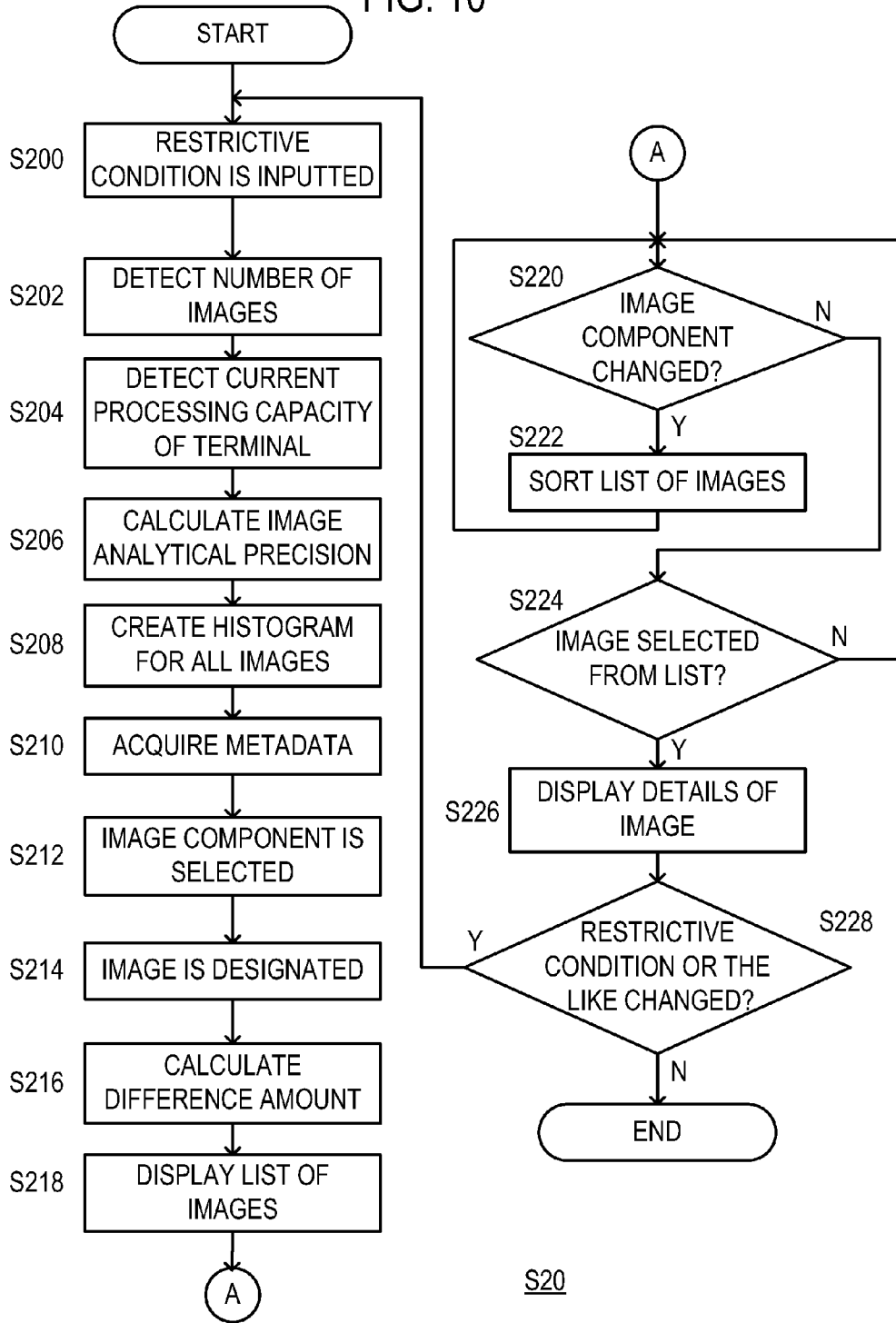


FIG. 10



S20

FIG. 11

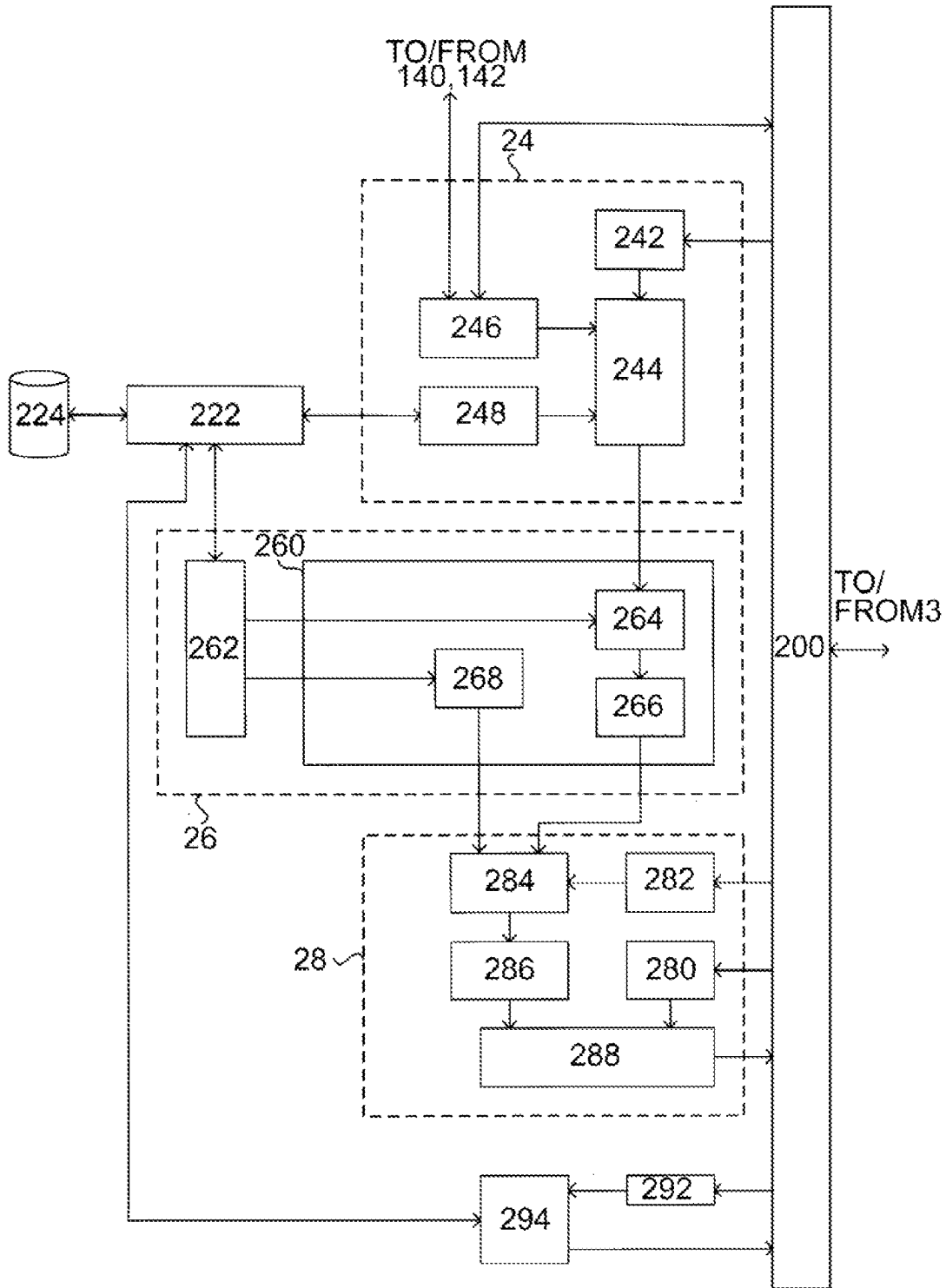


FIG. 12

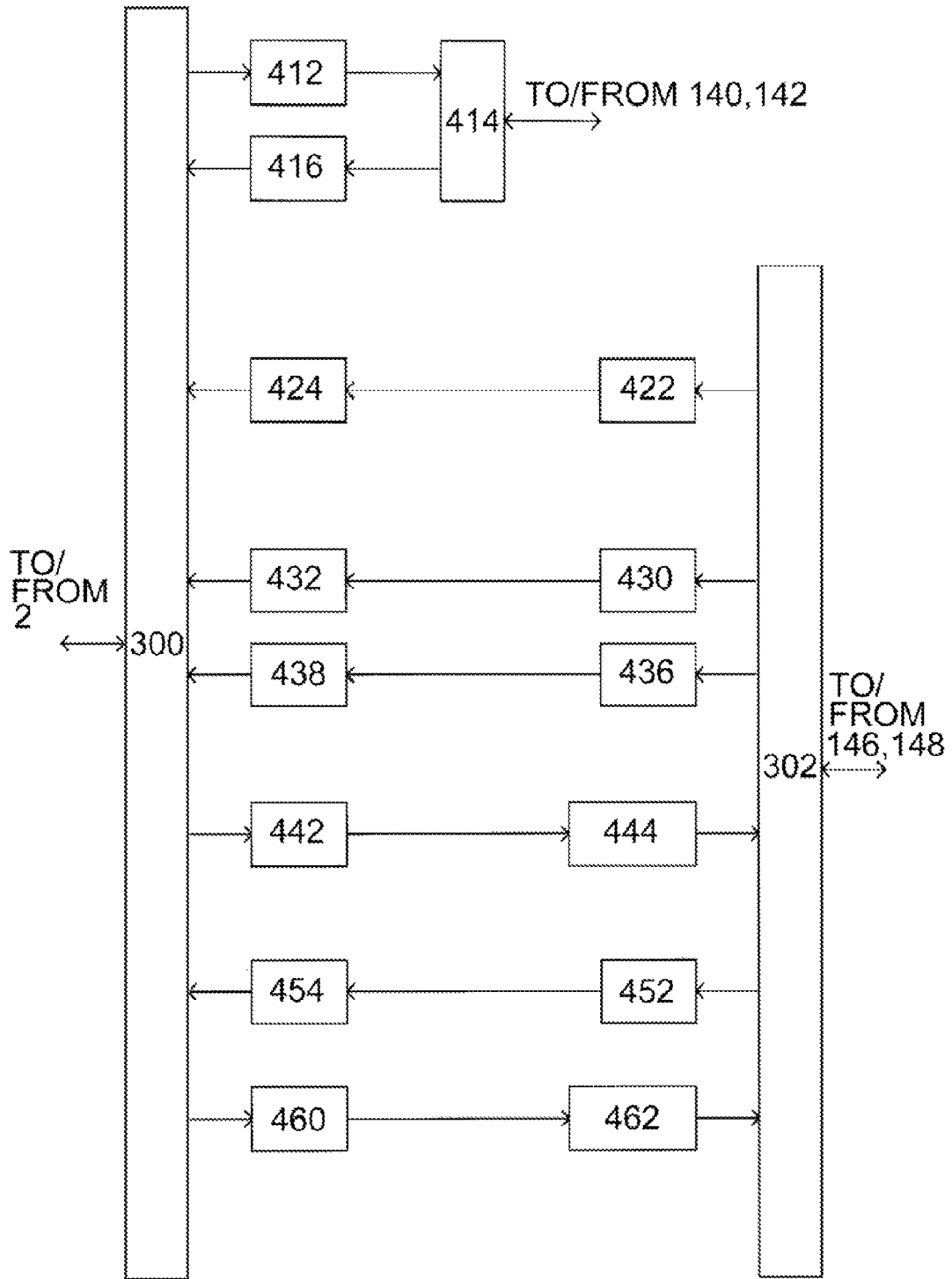


FIG. 13

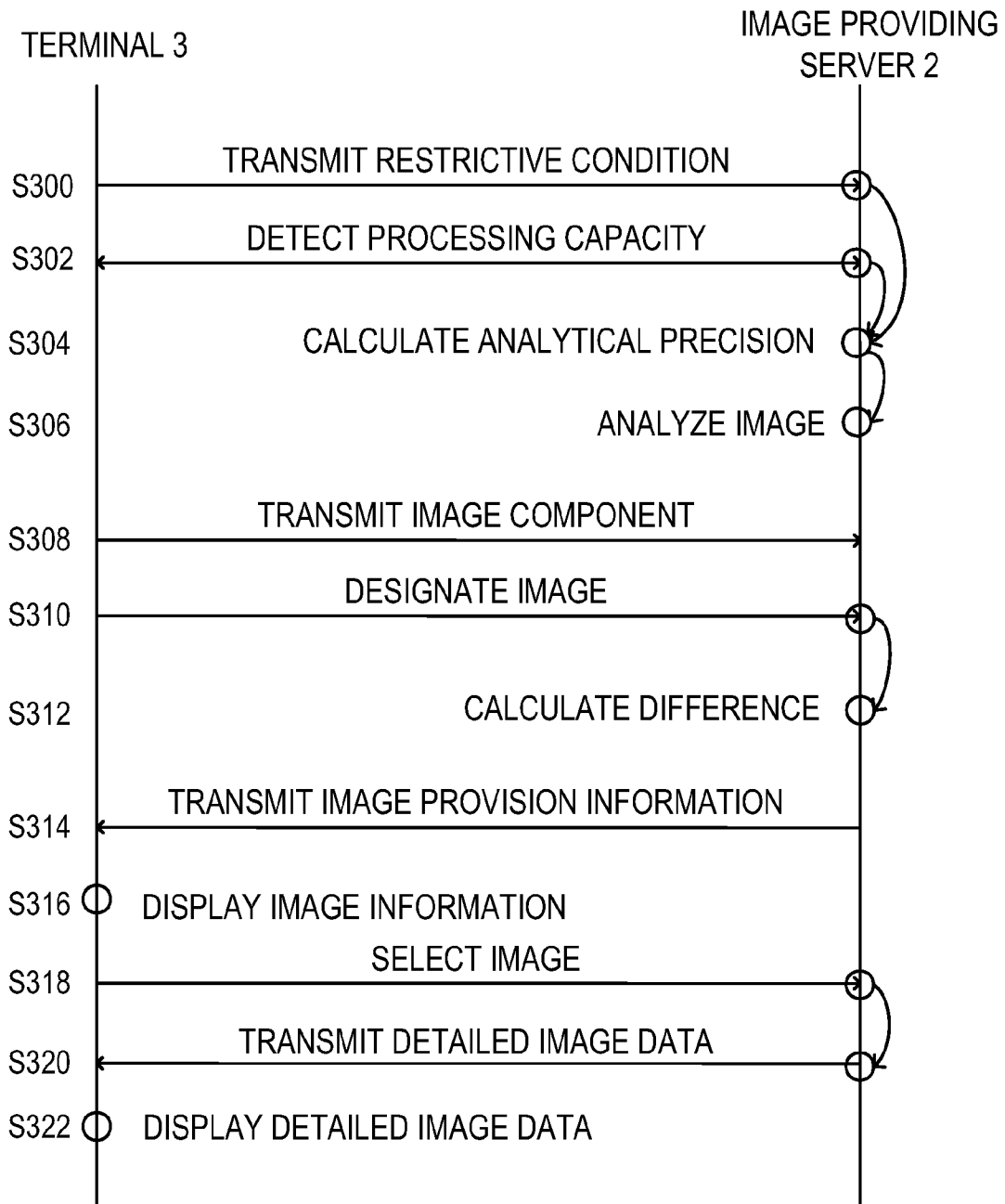




FIG. 14  
TO/FROM 2

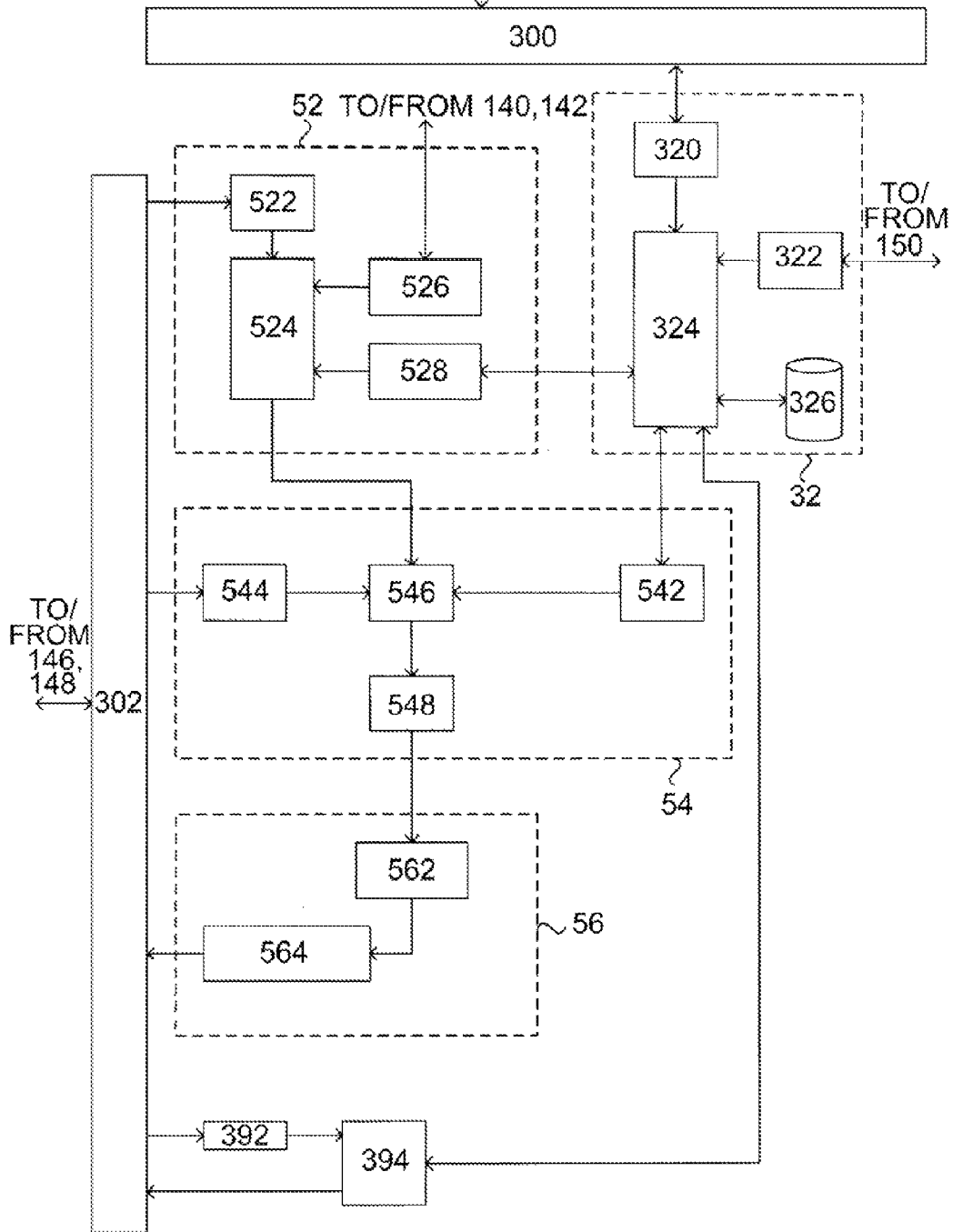


FIG. 15

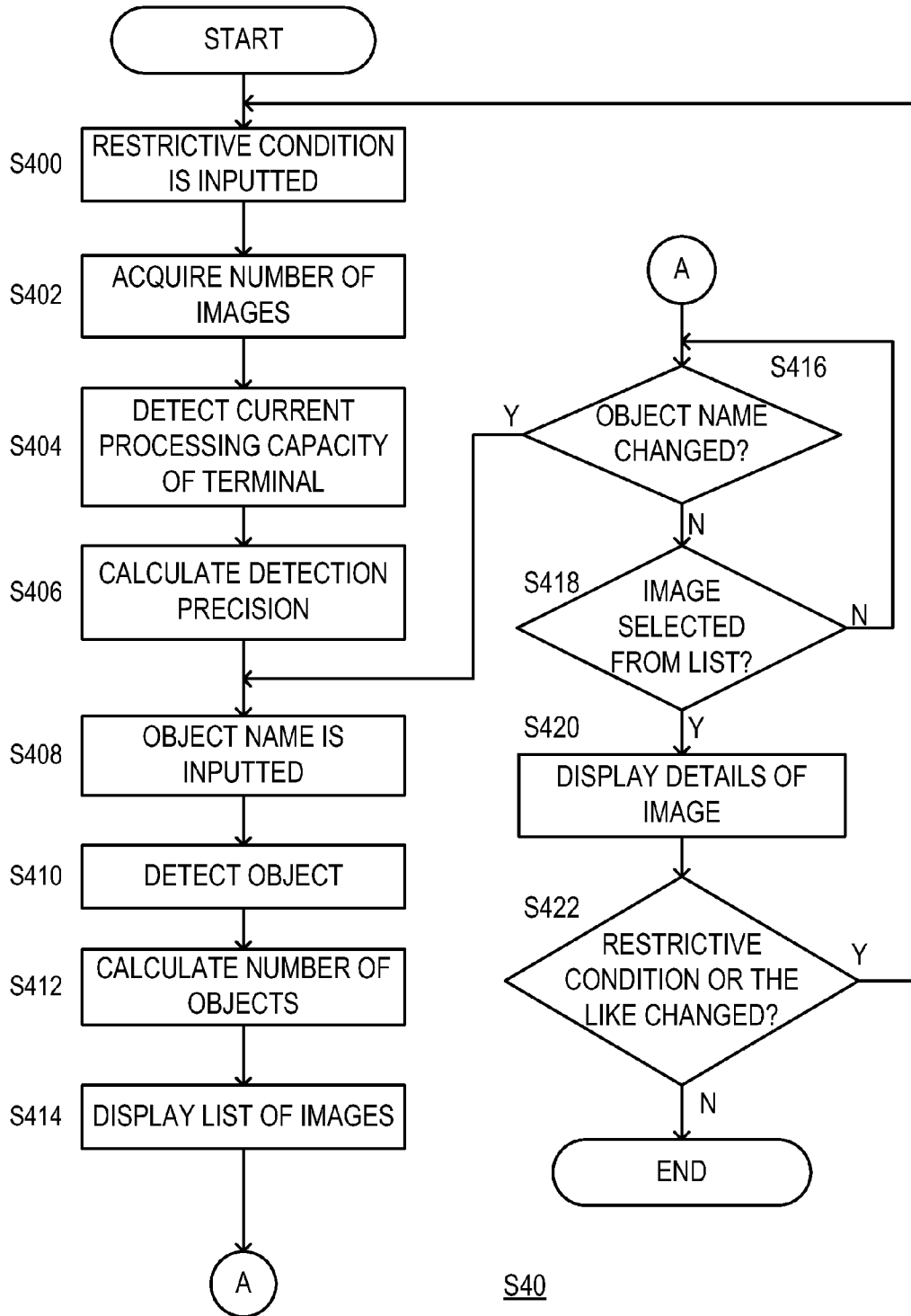


FIG. 16

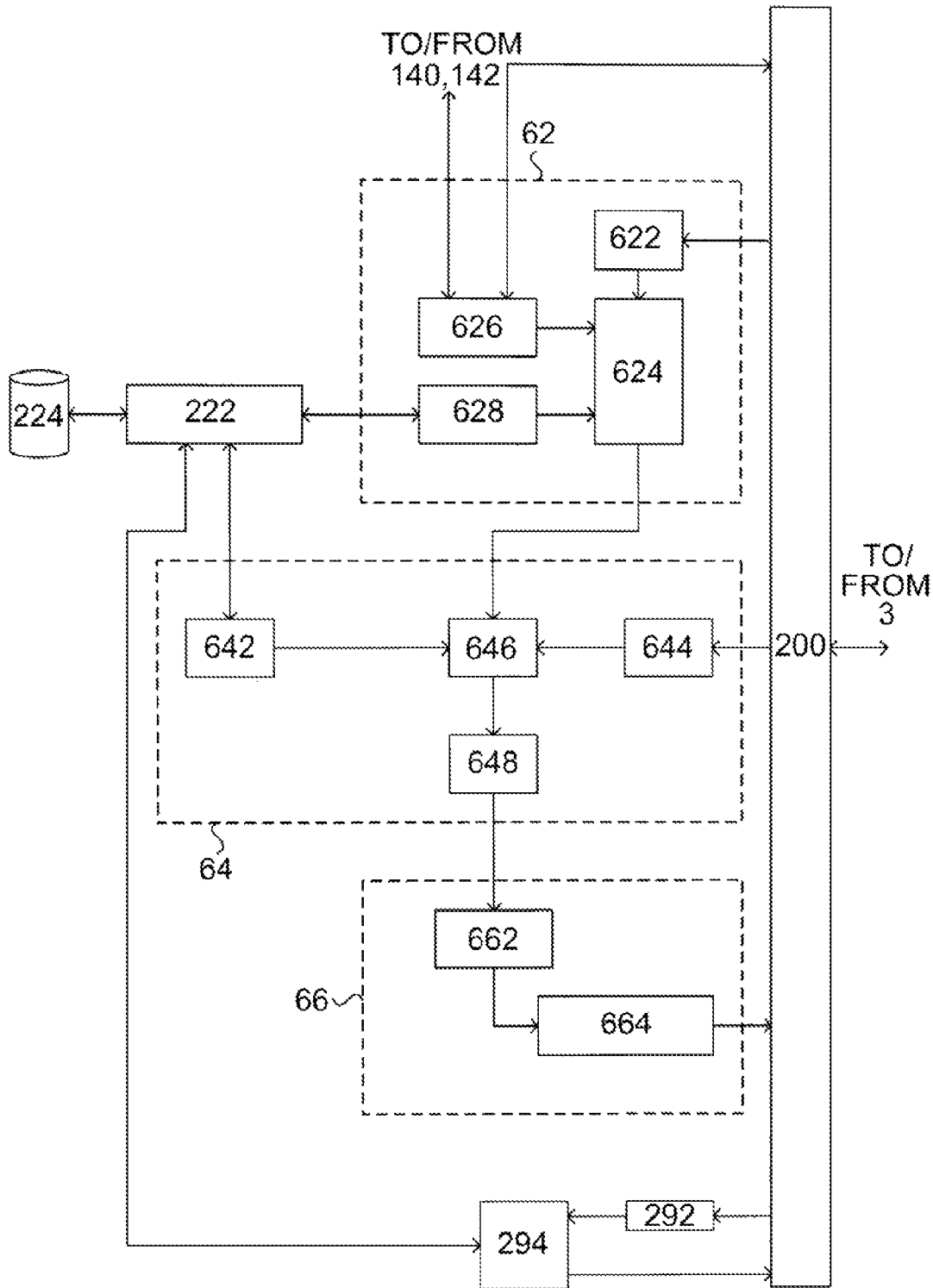


FIG. 17

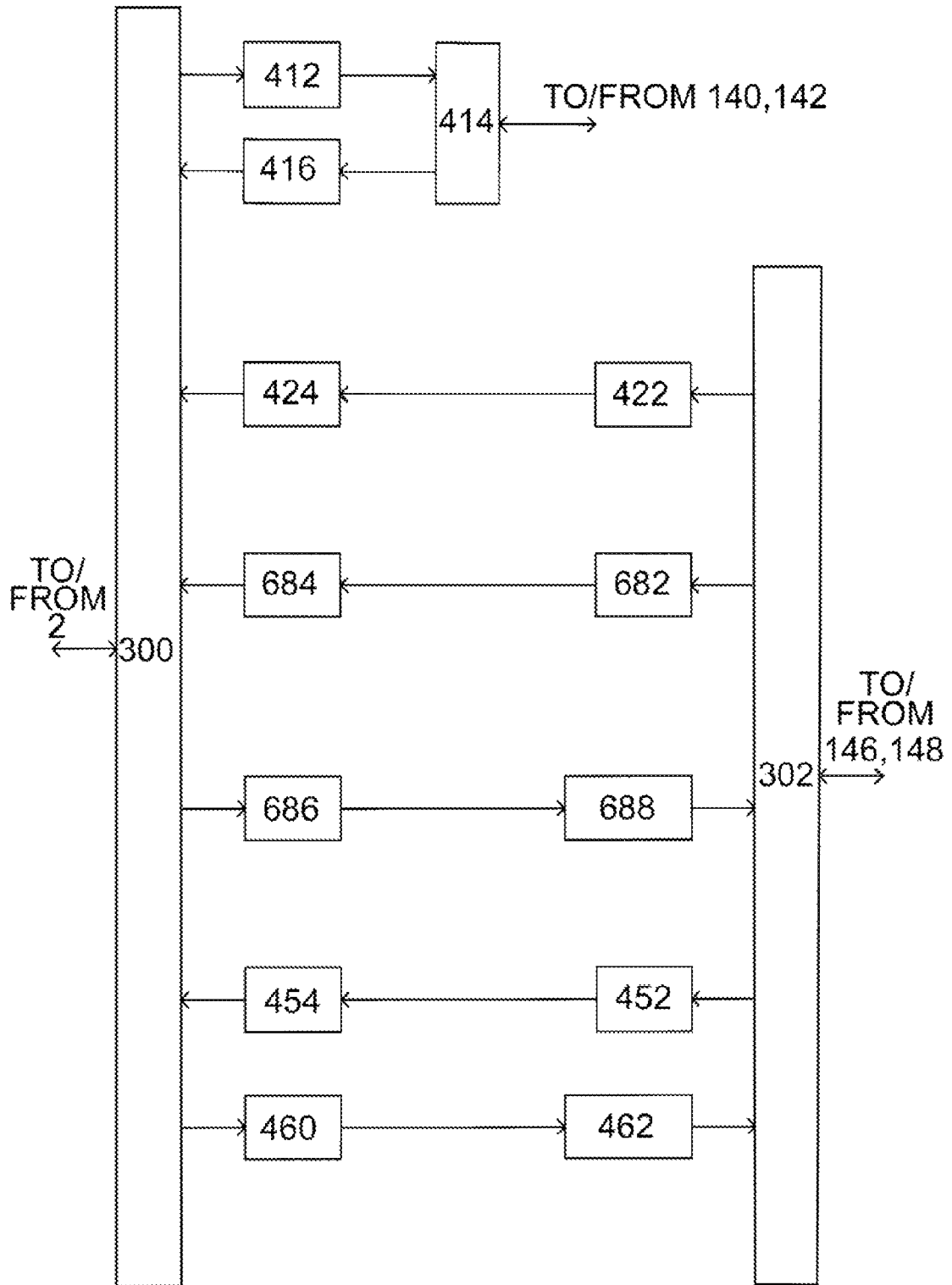
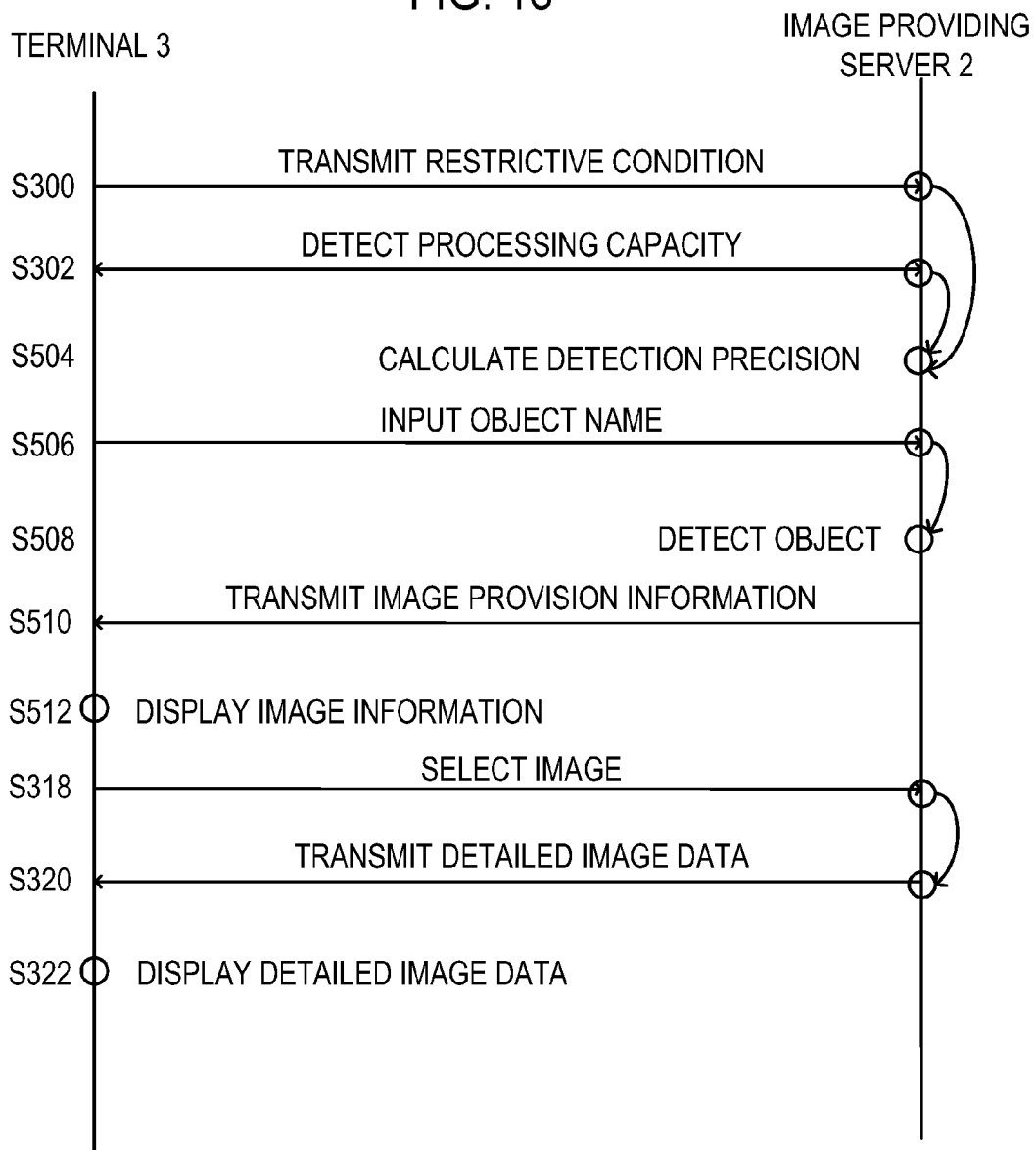


FIG. 18



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# IMAGE DISPLAY SYSTEM, IMAGE DISPLAY APPARATUS, IMAGE PROVIDING APPARATUS AND METHOD THEREOF

## CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a U.S. national stage application claiming the benefit of International Application No. PCT/JP2009/055108, filed on Mar. 17, 2009, the entire contents of which is incorporated herein by reference in its entirety.

## TECHNICAL FIELD

The present application discloses an image display system, an image display apparatus, an image providing apparatus, and a method thereof.

## BACKGROUND ART

For example, Non-Patent Documents 1 and 2 disclose an active meta-level system that dynamically interconnects devices such as databases.

Non-Patent Document 1: Shuichi Kurabayashi, Naoki Ishibashi, Yasushi Kiyoki: "Active Multidatabase System for Mobile Computing Environment", Information Processing Society of Japan SIG Notes 2000-DBS-122, 2000, 463-470.

Non-Patent Document 2: Shuichi Kurabayashi, Naoki Ishibashi, Yasushi Kiyoki: A Multidatabase System Architecture for Integrating Heterogeneous Databases with Meta-Level Active Rule Primitives. In Proceedings of the 20th IASTED International Conference on Applied Informatics, 2002, 378-387.

## DISCLOSURE OF THE INVENTION

### Means for Solving the Problems

An image display apparatus disclosed in the present application has been invented in consideration of such background, and an embodiment thereof is an image display apparatus that displays one or more pieces of image information which may respectively include one or more detection targets, the image display apparatus including: a calculating module that calculates a detection precision for detecting the detection target from the image information so as to satisfy a restrictive condition designated for the provision of the one or more pieces of image information; a detecting module that detects the detection target from each of the one or more pieces of image information at the calculated detection precision; and a providing module that creates and displays provision information in which the one or more pieces of image information are arranged based on the detection result.

## SUMMARY

An outline of the disclosure of the present application will now be described.

However, the present description is merely intended to assist in the understanding of the disclosure of the present application and is not intended to limit the technical scope thereof.

Significant improvements have been made in the CPU capability and the storage capacity of mobile devices such as mobile phones and PDAs (personal digital assistants),

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thereby enabling saving and operating multimedia data such as images and music in the mobile devices.

However, since such mobile devices generally lack sufficient computational resources as compared to conventional computer systems, accessing multimedia data requires a large amount of time.

An image display apparatus disclosed in the present application has been invented in consideration of the perspective described above, and is configured so as to: calculate a detection precision so as to satisfy a designated restrictive condition; detect a projection of a designated object from each image based on the calculated detection precision; calculate the number of projections of the designated object included in each image; and arrange the respective pieces of image information according to the numbers of detected projections of the object.

The technical advantages disclosed in the present application as well as other technical advantages will be readily apparent to one skilled in the art by reading the detailed descriptions of the embodiments illustrated in the drawings.

The accompanying drawings, which are incorporated in and constitute a part of the specification of the present application, illustrate embodiments of the disclosure of the present application and together with the descriptions, serve to explain the principles of the disclosure of the present application.

It is to be understood that, unless otherwise noted, the drawings referred to in the specification of the present application are not drawn to a constant scale.

## BRIEF DESCRIPTION OF THE DRAWINGS

The configurations and operations of the embodiments disclosed in the present application are best understood by reference to the following detailed description when read in conjunction with the accompanying drawings.

FIG. 1 is a diagram illustrating a configuration of an image display system to which the disclosure of the present application is applied;

FIG. 2 is a diagram illustrating a hardware configuration of an image providing server illustrated in FIG. 1;

FIG. 3 is a diagram illustrating a hardware configuration of a terminal illustrated in FIG. 1;

FIG. 4 is a diagram illustrating an image providing server program to be executed at the image providing server illustrated in FIGS. 1 and 2;

FIG. 5 is a diagram illustrating a structure of image information;

FIG. 6 is a diagram illustrating a terminal program to be executed at the terminal illustrated in FIGS. 1 and 3;

FIG. 7 is a diagram illustrating data to be created by a color percentage calculating unit;

FIG. 8 is a diagram illustrating difference data to be created by a difference calculating unit;

FIG. 9 is a diagram illustrating image sequence information;

FIG. 10 is a flowchart illustrating processing of the terminal program illustrated in FIG. 6;

FIG. 11 is a diagram illustrating a second image providing server program to be executed at the image providing server illustrated in FIGS. 1 and 2;

FIG. 12 is a diagram illustrating a second terminal program to be executed at the terminal illustrated in FIGS. 1 and 3;

FIG. 13 is a communication sequence diagram illustrating overall operations of an image display system according to a second embodiment;

FIG. 14 is a diagram illustrating a third terminal program to be executed at the terminal illustrated in FIGS. 1 and 3;

FIG. 15 is a flowchart illustrating processing of the third terminal program illustrated in FIG. 14;

FIG. 16 is a diagram illustrating a fourth image providing server program to be executed at the image providing server illustrated in FIGS. 1 and 2;

FIG. 17 is a diagram illustrating a fourth terminal program to be executed at the terminal illustrated in FIGS. 1 and 3; and

FIG. 18 is a communication sequence diagram illustrating overall operations of an image display system according to a fourth embodiment.

### BEST MODE FOR CARRYING OUT THE INVENTION

Hereinafter, embodiments disclosed in the present application will be described in detail.

The embodiments disclosed in the present application are exemplified in the accompanying drawings.

While the disclosure of the present application will be described with respect to the embodiments, the embodiments are not intended to limit the disclosure of the present application to the contents disclosed in the embodiments as would be understood by one skilled in the art.

On the contrary, the disclosure of the present application is intended to cover all alternatives, modifications and equivalents as may be included within the spirit and scope of the disclosure of the present application defined in the appended claims.

In addition, the description of the disclosure of the present application will be given with sufficient specificity and detail so as to ensure that the disclosure of the present application be understood.

However, as would be understood by one skilled in the art, implementations of the disclosure of the present application need not necessarily require the use of all items described with such specificity and detail.

Moreover, known methods, procedures, components and circuits may not necessarily be described in detail herein so as to avoid making the aspects of the present disclosure vague.

It should be kept in mind, however, that these and similar terms are to be associated with appropriate physical quantities and are merely convenient labels applied to these quantities.

As is apparent from the arguments below, unless specifically stated otherwise, it is appreciated that throughout the disclosure of the present application, arguments using terms such as "accepting" and "setting" refer to actions and processes of an electronic computing device such as a computer system.

An electronic computing device such as a computer system manipulates and converts data expressed as a physical (electronic) quantity in a register and a memory of the computer system into other data similarly expressed as a physical quantity residing in a computer system memory or register or other similar information storage, transmission, or display devices.

Furthermore, the disclosure of the present application is also suitable in other computer systems such as an optical computer and a mechanical computer.

#### [Image Display System 1]

Hereinafter, an image display system 1 will be described to which the disclosure of the present application is to be applied.

FIG. 1 is a diagram illustrating a configuration of the image display system 1 to which the disclosure of the present application is applied.

As illustrated in FIG. 1, the image display system 1 is configured such that an image providing server 2, terminals 3-1 to 3-N that are mobile phones, PDAs (personal digital assistants) capable of wireless communication, portable personal computers or the like, and a base station 102 that performs data transmission among the terminals 3-1 to 3-N via a wireless line, are connected via a network 100 that accommodates both wired and wireless communication.

In addition, the terminals 3-1 to 3-N are capable of receiving a radio wave signal for position detection from a GPS (global positioning system) satellite 104 at a location suitable for radio reception such as the outside.

Although N denotes an integer equal to or greater than 1, N does not necessarily always denote the same number.

In addition, when describing any one or more of a plurality of components such as the terminals 3-1 to 3-N, a simple abbreviation such as terminal 3 may be used.

Furthermore, components capable of becoming information communication and information processing entities such as the base station 102, the image providing server 2 and the terminal 3 may be collectively referred to as nodes.

The terminal 3 need not necessarily be a mobile terminal and may include a desktop computer that communicates with the network 100.

Moreover, hereinafter, substantially like components are to be assigned like reference numerals in the respective diagrams.

The image display system 1 uses these components to realize information processing at nodes and information communication between nodes.

#### [Hardware Configuration]

Hereinafter, hardware configurations of the respective nodes of the image display system 1 will be described.

FIG. 2 is a diagram illustrating a hardware configuration of the image providing server 2 illustrated in FIG. 1.

As illustrated in FIG. 2, the image providing server 2 is made up of: a communication apparatus 120 to be connected to the network 100 via a wireless communication line or a wired communication line; a CPU 140; a memory 142; a CPU peripheral 144 such as an interrupt control device, a timer device, and a recording medium interface that reads/writes data from/to a recording medium 154; an input device 146 such as a keyboard and a mouse; an output device 148 such as a display and a speaker; and a recording apparatus 152 such as an HDD or CD apparatus.

In other words, the image providing server 2 includes components of a general computer capable of performing information processing and information communication.

FIG. 3 is a diagram illustrating a hardware configuration of the terminal 3 illustrated in FIG. 1.

As illustrated in FIG. 3, the terminal 3 is made up of: a communication apparatus 120 to be connected to the network 100 via a wireless communication line or a wired communication line; a CPU 140; a memory 142; a CPU peripheral 144 such as an interrupt control device, a timer device, and a recording medium interface that reads/writes data from/to a recording medium 154; an input device 146 such as a numerical keypad and a microphone; an output device 148 such as a liquid crystal display and a speaker; a camera 150; and a GPS 160 that detects a position (longitude and latitude) of the terminal 3 or the like using a radio signal from the GPS satellite 104 (FIG. 1).

In other words, the terminal 3 includes components of a general computer capable of performing information processing and information communication.

Next, a first embodiment of the disclosure of the present application will be described.

[Image Providing Server Program 20]

FIG. 4 is a diagram illustrating an image providing server program 20 to be executed at the image providing server 2 illustrated in FIGS. 1 and 2.

As illustrated in FIG. 4, the image providing server program 20 includes a communication processing unit 200, a user interface unit (UI) 202, an image receiving unit 204, an image information managing unit 206, an image database (DB) 208, an image inputting unit 210, an image request receiving unit 212, and an image transmitting unit 214.

The image providing server program 20 is loaded on to the memory 142 of the image providing server 2 via the recording medium 154 (FIGS. 2 and 3), the network 100 and the like, and is executed specifically using hardware resources of the image providing server 2 on an OS (not illustrated) that runs on the image providing server 2 (the same logic will apply to the following programs and modules).

Using these components, the image providing server program 20 receives image information, to be described later, from the network 100 or the like, manages the image information, and transmits the image information in response to a request from the network 100.

In the image providing server program 20, the communication processing unit 200 performs processing for general information communication to be performed by the image providing server 2 and processing for information communication with the terminal 3 via the network 100.

The UI 202 accepts a user operation on the input device 146 and outputs data indicating the accepted operation to the image inputting unit 210.

In addition, the UI 202 controls processing to be performed by other components of the image providing server program 20.

The image receiving unit 204 receives image information from the network 100 and outputs the same to the image information managing unit 206.

The image inputting unit 210 accepts, via the UI 202, image information accepted by the recording apparatus 152 via the recording medium 154, and outputs the image information to the image information managing unit 206.

The image information managing unit 206 stores image information accepted from the image receiving unit 204 and the image inputting unit 210 into the image DB 208, and manages the image information.

The image request receiving unit 212 accepts information indicating a request for image information (image request information) from the network 100, and outputs the information to the image information managing unit 206.

The image information managing unit 206 acquires image information corresponding to the image request information from the image DB 208, and outputs the image information to the image transmitting unit 214.

The image transmitting unit 214 transmits the image information to the node having transmitted the image request information via the communication processing unit 200 and the network 100.

FIG. 5 is a diagram illustrating a structure of image information stored by the image information managing unit 206.

As illustrated in FIG. 5, image information includes an image identifier, metadata, and image data.

Metadata is data regarding image data, and includes: an image name; information (time information) regarding the time at which the image data was created (for example, the

time of photography of an image corresponding to the image data); and information (positional information) regarding a position at which the image was created (for example, the position where the image was photographed).

In this case, positional information can be acquired by, for example, the GPS 160 of the terminal 3 to be associated with a photographed image.

Image data includes: information indicating image positions #1 to #M (where M denotes an integer equal to or greater than 1 but does not necessarily always denote the same number) which are coordinate positions of, for example, pixels; and information (color information) regarding colors corresponding to the image positions.

[Terminal Program 30]

FIG. 6 is a diagram illustrating a terminal program 30 to be executed at the terminal 3 illustrated in FIGS. 1 and 3.

As illustrated in FIG. 6, the terminal program 30 includes a communication processing unit 300, a UI 302, an image storing module 32, an analytical precision calculating module 34, an image analyzing module 36, an image providing module 38, an image selecting unit 392, and a detailed image display processing unit 394.

Using these components, the terminal program 30 calculates an analytical precision of an image so as to satisfy a designated restrictive condition, and analyzes one or more images at the calculated analytical precision.

In addition, when displaying a designated image among the one or more images together with images other than the designated image, the terminal program 30 arranges the images in an order of analysis results of the images of nearest to farthest from the designated image.

In the terminal program 30, the communication processing unit 300 performs processing for audio communication and general information communication at the terminal 3 and processing for information communication with the image providing server 2 via the network 100.

The UI 302 displays an image (not illustrating) which prompts the user to input a restrictive condition, to be described later, designate an image, select a component of the image, and select the image on, for example, a display apparatus of the output device 148.

The UI 302 accepts operations made by the user in response to displayed GUI images from the input device 146, and outputs information corresponding to each operation to each corresponding module.

In addition, the UI 302 outputs an audio signal inputted from the microphone of the input device 146 to the communication processing unit 222, and outputs an audio signal inputted from the communication processing unit 300 to the speaker of the output device 148.

The image storing module 32 is made up of an image acquiring unit 320, a camera processing unit 322, an image information managing unit 324, and an image DB 326.

Using these components, the image storing module 32 acquires image information (FIG. 5) as a result of a user operation or the like, manages the image information, and outputs the image information in response to a request from another module.

The analytical precision calculating module 34 is made up of a restrictive condition inputting unit 342, an image analytical precision calculating unit 344, a processing capacity detecting unit 346, and an image-count detecting unit 348.

Using these components, the analytical precision calculating module 34 calculates an analytical precision of an image which satisfies a designated restrictive condition.



The image analyzing module **36** is made up of an image information acquiring unit **362** and an image component extracting unit **360**.

Using these components, the image analyzing module **36** analyzes image information based on a calculated analytical precision.

The image providing module **38** is made up of an image component selecting unit **380**, an image designating unit **382**, a difference calculating unit **384**, an image sequence creating unit **386**, and an image provision processing unit **388**.

Using these components, the image providing module **38** accepts an image designation, calculates differences between an analysis result of image information of the designated image and image information of images other than the designated image, and provides a list of images arranged in an ascending order of differences of the images as a search result.

At the image storing module **32**, the image acquiring unit **320** transmits image request information to the image providing server **2** via the communication processing unit **300** and the network **100**, and in response to the request, receives image information transmitted from the image providing server **2**.

In addition, the image acquiring unit **320** outputs received image information to the image information managing unit **324**.

The camera processing unit **322** acquires image data photographed by the camera **150**, the time at which the image data was photographed, and a position at which the image data was photographed in association with each other and creates image information, and outputs the image information to the image information managing unit **324**.

The image information managing unit **324** stores image information accepted from the image acquiring unit **320**, the camera processing unit **322**, and the recording medium **154** in the image DB **326**, and manages the image information.

In addition, the image information managing unit **324** acquires image information from the image DB **326** in response to a request from another module, and outputs the image information to the module having made the request.

At the analytical precision calculating module **34**, the restrictive condition inputting unit **342** performs processing so as to display a screen to be used by the user to input a restrictive condition on the output device **148** that is a liquid crystal screen or the like via the UI unit **302**, and to enable input of a restrictive condition using the input device **146** that is a numerical keypad or the like.

In addition, the restrictive condition inputting unit **342** outputs information (restrictive condition information) regarding the restrictive condition inputted by a user operation to the image analytical precision calculating unit **344**.

In this case, a restrictive condition refers to a restriction imposed from the moment the user requests an image search to the moment a desired image search result is displayed on the terminal **3**, and includes, for example, a time limit, a power consumption, and a display screen size.

When the restrictive condition is a time limit, a period of time from the moment the user requests an image search to the moment a desired image search result is displayed on the terminal **3** is to be set by a user operation.

When the restrictive condition is a power consumption, power to be consumed from the moment the user requests an image search to the moment a desired image search result is displayed on the terminal **3** is to be set by a user operation.

If the restrictive condition is a display screen size, a size of a display screen when a desired image search result is displayed on the terminal **3** is to be set by a user operation.

The restrictive condition inputting unit **342** may be arranged so as to cause any of a time limit, a power consumption, and a display screen size to be selected as a restrictive condition.

For example, the restrictive condition inputting unit **342** displays a screen that enables selection of "time limit", "power consumption" or "display screen size" on the output device **148**.

When "time limit" is selected by a user operation, the restrictive condition inputting unit **342** displays a screen for inputting or selecting a time limit.

When a time limit is inputted or selected by a user operation, the restrictive condition inputting unit **342** accepts time information as a restrictive condition information.

By accessing the CPU **140**, the memory **142**, and the like, the processing capacity detecting unit **346** detects a current processing capacity of the terminal **3**.

In addition, the processing capacity detecting unit **346** outputs information (processing capacity information) regarding the detected processing capacity to the image analytical precision calculating unit **344**.

The image-count detecting unit **348** outputs a signal for detecting the number of pieces of image information stored in the image DB **326** to the image information managing unit **324**.

In response to the signal from the image-count detecting unit **348**, the image information managing unit **324** detects the number of pieces of image information stored in the image DB **326**, and outputs information (image-count information) indicating the number thereof to the image-count detecting unit **348**.

The image-count detecting unit **348** outputs the image-count information from the image information managing unit **324** to the image analytical precision calculating unit **344**.

The image analytical precision calculating unit **344** uses the accepted restrictive condition information, processing capacity information, and image-count information to calculate a precision of image analysis (image analytical precision) necessary for searching an image.

In addition, the image analytical precision calculating unit **344** outputs the calculated image analytical precision to the image analyzing module **36**.

In this case, an image analytical precision refers to a fineness (degree) when analyzing image information and determines the accuracy of a degree of similarity (difference) when comparing a piece of image information with another piece of image information.

For example, when precision is high, a finer analysis result is obtained. Consequently, when searching for image information similar to image information A, it is more likely that image information similar to the image information A will be retrieved.

At the same time, a higher precision results in a greater throughput. In other words, the time necessary for processing increases.

For example, when image analysis involves analyzing color, the level of image analytical precision can be determined by controlling chromatic resolution (chromatic depth).

An example will be shown below of a case where time limit is selected as a restrictive condition and a level of chromatic resolution (chromatic depth) is adopted as an image analytical precision.

If  $m$  denotes the number of pieces of image information (images),  $n$  denotes chromatic resolution,  $P_t$  denotes a computation time per color per image (including the time required by processing performed by the image providing module **38**),  $A_t$  denotes the time required for processing other than image

analysis (for example, the processing time regarding the display device **148**), and T denotes a time limit designated by the user, then the following expression is true.

$$m * Pt * n + \Delta t \leq T \quad (\text{Expression 1})$$

In this case, if m=100, Pt=0.001 [seconds], T=3 [seconds], and  $\Delta t=0$ , then n is calculated to be 30.

In other words, in the case described above, setting chromatic resolution to 30 will suffice to set the period of time required from the moment the user requests an image search to the moment a desired image search result is displayed on the terminal **3** to 3 seconds.

Alternatively, Pt may denote a function of the current processing capacity of the terminal **3**.

Moreover, image analytical precision may be applied to image display in addition to image analysis.

At the image analyzing module **36**, the image information acquiring unit **362** outputs a signal for acquiring image information stored in the image DB **326** to the image information managing unit **324**.

In response to the signal from the image information acquiring unit **362**, the image information managing unit **324** outputs image information stored in the image DB **326** to the image information acquiring unit **362**.

In this manner, the image information acquiring unit **362** acquires image information from the image information managing unit **324**.

The image component extracting unit **360** extracts an image component from the image information acquiring unit **362**, and performs an image analysis according to the image component.

Image analysis is performed so as to enable calculation of a difference between a piece of image information and another piece of image information.

In this case, an image component refers to a component indicating a characteristic of image information and is, for example, color information, time information, and positional information.

The image component extracting unit **360** is made up of, for example, a color classifying unit **364**, a color percentage calculating unit **366**, and a metadata acquiring unit **368**.

The metadata acquiring unit **368** acquires metadata (time information, positional information) from the image information acquiring unit **362** and outputs the metadata to the image providing module **38**.

The color classifying unit **364** acquires image information from the image information acquiring unit **362** and classifies, for each piece of image information, used colors according to a chromatic resolution n calculated by the image analytical precision calculating unit **344**.

For instance, since n=30 is set in the example described above, used colors are classified into 30 colors for each piece of image information.

For each piece of image information, the color percentage calculating unit **366** calculates a percentage (color percentage) at which classified colors are used in the image, and creates an n-color histogram for each image.

For example, the percentage of a portion classified as "blue" is calculated to be 16% and the percentage of a portion classified as "red" is calculated to be 12%.

In addition, the color percentage calculating unit **366** outputs information (color percentage information) regarding calculated color percentages to the image providing module **38**.

FIG. 7 is a diagram illustrating data to be created by the color percentage calculating unit **366**, wherein FIG. 7(A) illustrates color percentage information and FIG. 7(B) illustrates a histogram.

Color percentage information is created for each piece of image information and includes an image identifier, color percentage information, and image data.

Color percentage information includes information regarding color types (color #1, color #2, . . . , color #n), and numerical data regarding each percentage.

At the image providing module **38** (FIG. 6), the image component selecting unit **380** performs processing so as to display a screen to be used by the user to select an image component (for example, color information, time information, and positional information) on the output device **148** that is a liquid crystal screen or the like via the UI unit **302**, and to enable selection of an image component using the input device **146** that is a numerical keypad or the like.

In addition, the image component selecting unit **380** outputs an image component selected by a user operation to the image provision processing unit **388**.

The image designating unit **382** accepts image information designated by a user operation via the UI unit **302** and outputs the image information to the difference calculating unit **384**.

The difference calculating unit **384** accepts color percentage information (FIG. 7(A)) regarding all image information from the color percentage calculating unit **366**, and accepts metadata regarding all image information from the metadata acquiring unit **368**.

In addition, the difference calculating unit **384** compares color percentage information regarding designated image information with color percentage information regarding other image information, and calculates a difference amount indicating a degree of similarity between the designated image information and the other image information.

Specifically, a comparison is performed on each color included in the color percentage information, and a difference amount (color difference amount) is calculated from the comparison result for each piece of image information.

In addition, the difference calculating unit **384** compares metadata (time information, positional information) regarding designated image information with metadata regarding other image information, and calculates a difference amount (time difference amount, positional difference amount) regarding metadata for each piece of image information.

Furthermore, the difference calculating unit **384** creates difference data illustrated in FIG. 8 for each piece of image information from the calculated difference amount and outputs the difference data to the image sequence creating unit **386**.

FIG. 8 is a diagram illustrating difference data to be created by the difference calculating unit **384**.

As illustrated in FIG. 8, difference data includes an image identifier, a color difference amount, a time difference amount, a positional difference amount, and image data.

In this case, with difference data regarding image information designated by the user, the color difference amount, the time difference amount, and the positional difference amount all take values of 0.

Based on the difference data, the image sequence creating unit **386** (FIG. 6) creates image sequence information so as to arrange image information in an ascending order of difference amount for each image component (color, time, and position), and outputs the image sequence information to the image provision processing unit **388**.

FIG. 9 is a diagram illustrating image sequence information.

As illustrated in FIG. 9, image sequence information respectively includes image sequence data for color, time, and position. Image sequence data includes an image identifier and image data arranged as described above.

In this case, image information designated by the user comes at the top of image sequence data.

Based on image sequence data corresponding to the image component from the image component selecting unit 380, the image provision processing unit 388 (FIG. 6) performs processing necessary for providing image information to the output device 148 such as a liquid crystal display screen.

Due to the processing by the image provision processing unit 388, image information is arranged and displayed on the display screen in an order in which image information is determined to be similar to the image information designated by the user.

The image information to be displayed by this process may be image names of image information or thumbnails of image data.

The image selecting unit 392 accepts an identifier of image information selected by a user operation performed on the input device 146 via the UI unit 302, and outputs the image information identifier to the detailed image display processing unit 394.

The detailed image display processing unit 394 acquires image information corresponding to the image identifier from the image information managing unit 324, and performs processing necessary for displaying more detailed image data on the output device 148.

Hereinafter, overall processing of the terminal program 30 will be described.

FIG. 10 is a flowchart (S20) illustrating processing of the terminal program 30 illustrated in FIG. 6.

As illustrated in FIG. 10, in step 200 (S200), the restrictive condition inputting unit 342 accepts restrictive condition information (time limit, power consumption, display screen size, or the like) inputted by a user operation.

In step 202 (S202), the image-count detecting unit 348 detects the number of pieces of image information stored in the image DB 326.

In step 204 (S204), by accessing the CPU 140, the memory 142, and the like, the processing capacity detecting unit 346 detects a current processing capacity of the terminal 3.

In step 206 (S206), the image analytical precision calculating unit 344 calculates an image analytical precision necessary for searching an image.

In step 208 (S208), the color percentage calculating unit 366 calculates a color percentage for each piece of image information and creates a histogram for each image.

In step 210 (S210), the metadata acquiring unit 368 acquires metadata (time information, positional information) from the image information acquiring unit 362.

In step 212 (S212), the image component selecting unit 380 accepts an image component (color information, time information, positional information) inputted by a user operation.

In step 214 (S214), the image designating unit 382 accepts image information designated by a user operation.

In step 216 (S216), the difference calculating unit 384 calculates, for each piece of image information, a difference amount indicating a difference between designated image information and other image information.

In step 218 (S218), due to the processing by the image provision processing unit 388, image information is arranged and displayed on the display screen in an order in which image information is determined to be similar to the designated image information.

At this point, if "color" is selected as the image component, image information is arranged in an ascending order of color difference amounts.

Moreover, when time limit is selected as restrictive condition information, the processing times of S214 to S218 are to be limited.

In step 220 (S220), the image component 380 determines whether a change to the image component (color information, time information, positional information) by a user operation has been accepted or not.

If a change has been accepted, processing proceeds to S222, and if not, processing proceeds to S224.

In step 222 (S222), due to the processing by the image provision processing unit 388, for changed image components, image information is arranged and displayed on the display screen in an order in which image information is determined to be similar to the image information designated by the user.

For example, when the image component has been changed from color to time, display is changed so that image information is arranged in an order of nearest to farthest from the time of photography of the designated image.

In step 224 (S224), a determination is made on whether or not image information has been selected by a user operation.

If image information has been selected, processing proceeds to S226. If not, processing returns to S220.

In step 226 (S226), the detailed image display processing unit 394 causes detailed image data of the selected image to be displayed on the output device 148.

In step 228 (S228), a determination is made on whether or not the restrictive condition, the number of images, and the current processing capacity of the terminal have been changed.

If it is determined that a change has been made, processing returns to S200. If not, processing is terminated.

It should be noted that the sequence of the respective processes or the like illustrated in FIG. 10 may be modified as deemed appropriate.

The flowcharts, sequences and the like described below may similarly be modified as deemed appropriate.

Moreover, an arrangement is also possible in which: the image component selecting unit 380 accepts a selection of an image component before an image analytical precision is calculated by the image analytical precision calculating unit 344; the image analytical precision calculating unit 344 calculates only an image analytical precision corresponding to the selected image component; and the image analyzing module 36 performs image analysis only according to the selected image component (the same logic also applies to other embodiments to be described below).

In addition, while the embodiment described above is arranged so as to limit the time required for the processing of the image providing module 38 when time limit is the restrictive condition, an arrangement is also possible in which the times required by the processing of the image analyzing module 36 as well as the processing of the image providing module 38 are limited (the same logic also applies to other embodiments to be described below).

In this case, an arrangement is also possible in which, before an image analytical precision is calculated by the image analytical precision calculating unit 344, the image component selecting unit 380 accepts a selection of an image component and the image designating unit 382 accepts a designation of an image (the same logic also applies to other embodiments to be described below).

Next, a second embodiment of the disclosure of the present application will be described.

[Image Providing Server Program 22]

FIG. 11 is a diagram illustrating a second image providing server program 22 to be executed at the image providing server 2 illustrated in FIGS. 1 and 2 in place of the image providing server program 20.

As illustrated in FIG. 11, the second image providing server program 22 is made up of a communication processing unit 200, an image information managing unit 222, an image database (DB) 224, an analytical precision calculating module 24, an image analyzing module 26, an image providing module 28, an image selection receiving unit 292, and a detailed image data transmitting unit 294.

Using these components, the image providing server program 22 calculates an analytical precision of an image so as to satisfy a designated restrictive condition, and analyzes one or more images at the calculated analytical precision.

In addition, when displaying a designated image among the one or more images together with images other than the designated image, the image providing server program 22 arranges the images in an order of analysis results of the images of nearest to farthest from the designated image.

In the image providing server program 22, the image information managing unit 222 stores image information acquired via the network 100, the recording medium 154 and the like into the image DB 224, manages image information stored in the image DB 224, and, in response to a request from another module, acquires image information from the image DB 224 and outputs the image information to the module having made the request.

The analytical precision calculating module 24 is made up of a restrictive condition receiving unit 242, an image analytical precision calculating unit 244, a processing capacity detecting unit 246, and an image-count detecting unit 248.

Using these components, the analytical precision calculating module 24 calculates an analytical precision of an image which satisfies a designated restrictive condition.

The image analyzing module 26 is made up of an image information acquiring unit 262 and an image component extracting unit 260.

Using these components, the image analyzing module 26 analyzes image information based on a calculated analytical precision.

The image providing module 28 is made up of an image component receiving unit 280, an image designation receiving unit 282, a difference calculating unit 284, an image sequence creating unit 286, and an image provision information transmitting unit 288.

Using these components, the image providing module 28 accepts an image designation, calculates differences between an analysis result of image information of the designated image and image information of images other than the designated image, and provides a list of images arranged in an ascending order of differences as a search result.

In the analytical precision calculating module 24, the restrictive condition receiving unit 242 receives restrictive condition information regarding a restrictive condition designated by a user from the terminal 3 via the network 100 and the communication processing unit 200, and outputs the restrictive condition information to the image analytical precision calculating unit 244.

In the same manner as the processing capacity detecting unit 346 of the terminal program 30, by accessing the CPU 140, the memory 142, and the like of the terminal 3, the

processing capacity detecting unit 246 detects a current processing capacity of the terminal 3.

In addition, by accessing the CPU 140, the memory 142, and the like of the image providing server 2, the processing capacity detecting unit 246 detects a current processing capacity of the image providing server 2.

Furthermore, the processing capacity detecting unit 246 checks the communication state between the image providing server 2 and the terminal 3 and detects a current communication capacity (data transmission speed or the like) of the network 100 or the like.

Moreover, the processing capacity detecting unit 246 outputs information (processing capacity information) regarding the detected processing capacities to the image analytical precision calculating unit 244.

In the same manner as the image-count detecting unit 348 of the terminal program 30, the image-count detecting unit 248 outputs a signal for detecting the number of pieces of image information stored in the image DB 224 to the image information managing unit 222.

In response to the signal from the image-count detecting unit 248, the image information managing unit 222 detects the number of pieces of image information stored in the image DB 224, and outputs image-count information to the image-count detecting unit 248.

The image-count detecting unit 248 outputs the image-count information from the image information managing unit 222 to the image analytical precision calculating unit 244.

In the same manner as the image analytical precision calculating unit 344 of the terminal program 30, the image analytical precision calculating unit 244 uses the accepted restrictive condition information, processing capacity information, and image-count information to calculate an image analytical precision necessary for searching an image.

In addition, the image analytical precision calculating unit 244 outputs the calculated image analytical precision to the image analyzing module 26.

In the same manner as the image information acquiring unit 362 of the terminal program 30, the image information acquiring unit 262 in the image analyzing module 26 acquires image information from the image information managing unit 222.

In the same manner as the image component extracting unit 360 of the terminal program 30, the image component extracting unit 260 extracts an image component from the image information acquiring unit 262 and performs an image analysis according to the image component.

In the same manner as the image component extracting unit 360 of the terminal program 30, the image component extracting unit 260 is made up of, for example, a color classifying unit 264, a color percentage calculating unit 266, and a metadata acquiring unit 268.

In the same manner as the metadata acquiring unit 368 of the terminal program 30, the metadata acquiring unit 268 acquires metadata (time information, positional information) from the image information acquiring unit 262 and outputs the metadata to the image providing module 28.

In the same manner as the color classifying unit 364 of the terminal program 30, the color classifying unit 264 acquires image information from the image information acquiring unit 262 and classifies, for each piece of image information, used colors according to a chromatic resolution  $n$  calculated by the image analytical precision calculating unit 244.

In the same manner as the color percentage calculating unit 366 of the terminal program 30, the color percentage calcu-

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lating unit **266** calculates a color percentage for each piece of image information and creates an n-color histogram for each image.

In addition, the color percentage calculating unit **266** outputs calculated color percentage information to the image providing module **28**.

In the image providing module **28**, the image component receiving unit **280** receives an image component selected by the user from the terminal **3** via the network **100** and the communication processing unit **200**, and outputs the image component to the image provision information transmitting unit **288**.

The image designation receiving unit **282** receives image information designated by the user from the terminal **3** via the network **100** and the communication processing unit **200**, and outputs the image information to the difference calculating unit **284**.

In the same manner as the difference calculating unit **384** of the terminal program **30**, the difference calculating unit **284** accepts color percentage information (FIG. 7(A)) regarding all image information from the color percentage calculating unit **266**, and accepts metadata regarding all image information from the metadata acquiring unit **268**.

In addition, in the same manner as the difference calculating unit **384** of the terminal program **30**, the difference calculating unit **284** compares color percentage information regarding designated image information with color percentage information regarding other image information, and calculates a difference amount indicating a degree of similarity between the designated image information and the other image information.

Furthermore, in the same manner as the difference calculating unit **384** of the terminal program **30**, the difference calculating unit **284** compares metadata (time information, positional information) regarding designated image information with metadata regarding other image information, and calculates a difference amount (time difference amount, positional difference amount) regarding metadata for each piece of image information.

Moreover, the difference calculating unit **284** creates difference data illustrated in FIG. **8** for each piece of image information from the calculated difference amount and outputs the difference data to the image sequence creating unit **286**.

In the same manner as the image sequence creating unit **386** of the terminal program **30**, based on the difference data, the image sequence creating unit **286** creates image sequence information such that image information is arranged in an ascending order of difference amount for each image component (color, time, and position), and outputs the image sequence information to the image provision information transmitting unit **288**.

In the same manner as the image provision processing unit **388** of the terminal program **30**, based on image sequence data corresponding to the image component from the image component selecting unit **280**, the image provision information transmitting unit **288** performs processing necessary for providing image information to the output device **148** such as a liquid crystal display screen of the terminal **3**.

In addition, the image provision information transmitting unit **288** transmits image provision information generated by the processing described above to the terminal **3** via the communication processing unit **200** and the network **100**.

The image selection receiving unit **292** receives an identifier of the image information selected by the user from the terminal **3** via the network **100** and the communication pro-

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cessing unit **200**, and outputs the identifier to the detailed image data transmitting unit **294**.

The detailed image data transmitting unit **294** acquires image information corresponding to the image identifier from the image information managing unit **222**, and transmits more detailed image data to the terminal **3** via the communication processing unit **200** and the network **100**.

[Terminal Program **40**]

FIG. **12** is a diagram illustrating a second terminal program **40** to be executed at the terminal **3** illustrated in FIGS. **1** and **3** in place of the terminal program **30**.

As illustrated in FIG. **12**, the second terminal program **40** is made up of a communication processing unit **300**, a UI **302**, a processing capacity detection receiving unit **412**, a processing capacity detecting unit **414**, a processing capacity information transmitting unit **416**, a restrictive condition inputting unit **422**, a restrictive condition transmitting unit **424**, an image component inputting unit **430**, an image component transmitting unit **432**, an image designation inputting unit **436**, an image designation transmitting unit **438**, an image provision information receiving unit **442**, an image display processing unit **444**, an image selection inputting unit **452**, an image selection transmitting unit **454**, a detailed image data receiving unit **460**, and a detailed image display processing unit **462**.

In the terminal program **40**, the processing capacity detection receiving unit **412** receives a signal for detecting the processing capacities of the CPU **140** and the memory **142** of the terminal **3** from the image providing server **2** via the network **100** and the communication processing unit **300**, and outputs the signal to the processing capacity detecting unit **414**.

By accessing the CPU **140**, the memory **142**, and the like, the processing capacity detecting unit **414** detects a current processing capacity of the terminal **3**.

In addition, the processing capacity detecting unit **414** outputs information (processing capacity information) regarding the detected processing capacity to the processing capacity information transmitting unit **416**.

The processing capacity information transmitting unit **416** outputs the processing capacity information from the processing capacity detecting unit **414** to the image providing server **2** via the network **100** and the communication processing unit **300**.

In the same manner as the restrictive condition inputting unit **342** of the terminal program **30**, the restrictive condition inputting unit **422** performs processing so as to display a screen to be used by the user to input a restrictive condition on the output device **148** that is a liquid crystal screen or the like via the UI unit **302**, and to enable input of a restrictive condition using the input device **146** that is a numerical keypad or the like.

In addition, the restrictive condition inputting unit **422** outputs restrictive condition information inputted by a user operation to the restrictive condition transmitting unit **424**.

The restrictive condition transmitting unit **424** transmits the restrictive condition information from the restrictive condition inputting unit **422** to the image providing server **2** via the network **100** and the communication processing unit **300**.

The image component inputting unit **430** performs processing so as to display a screen to be used by the user to select an image component (for example, color information, time information, and positional information) on the output device **148** that is a liquid crystal screen or the like via the UI unit **302**, and to enable selection of an image component using the input device **146** that is a numerical keypad or the like.

In addition, the image component inputting unit **430** outputs an image component selected by a user operation to the image component transmitting unit **432**.

The image component transmitting unit **432** transmits the image component information selected by the user to the image providing server **2** via the network **100** and the communication processing unit **300**.

The image designation inputting unit **436** accepts image information designated by a user operation via the UI unit **302** and outputs the image information to the image designation transmitting unit **438**.

The image designation transmitting unit **438** transmits the image information designated by the user to the image providing server **2** via the network **100** and the communication processing unit **300**.

The image provision information receiving unit **442** receives image provision information from the image providing server **2** via the network **100** and the communication processing unit **300**, and outputs the image provision information to the image display processing unit **444**.

Based on the image provision information from the image display processing unit **444**, the image display processing unit **444** performs processing necessary for displaying image information on the output device **148** that is a liquid crystal display screen or the like.

The image information to be displayed may be image names of image information or thumbnails of image data.

The image selection inputting unit **452** accepts an identifier of image information selected by a user operation performed on the input device **146** via the UI unit **302**, and outputs the image information identifier to the image selection transmitting unit **454**.

The image selection transmitting unit **454** transmits the identifier of the image information selected by the user to the image providing server **2** via the network **100** and the communication processing unit **300**.

The detailed image data receiving unit **460** receives more detailed image data from the image providing server **2** via the network **100** and the communication processing unit **300**, and outputs the more detailed image data to the detailed image display processing unit **462**.

The detailed image display processing unit **462** performs processing necessary for displaying more detailed image data on the output device **148**.

[Overall Operations of Image Display System 1]

Hereinafter, overall operations of the image display system **1** according to the second embodiment will be described.

FIG. **13** is a communication sequence diagram illustrating overall operations (S**30**) of the image display system **1** according to the second embodiment illustrated in FIG. **1**.

As illustrated in FIG. **13**, in step **300** (S**300**), the terminal **3** transmits restrictive condition information to the image providing server **2**.

In step **302** (S**302**), the image providing server **2** detects current processing capacities of the terminal **3** and the image providing server **2** and a current communication capacity of a communication channel such as the network **100**.

In step **304** (S**304**), the image providing server **2** calculates an image analytical precision based on the restrictive condition information and current processing capacities.

In step **306** (S**306**), the image providing server **2** performs an image analysis for searching an image on each piece of image information.

In step **308** (S**308**), the terminal **3** transmits an image component (color information, time information, positional information) inputted by a user operation to the image providing server **2**.

In step **310** (S**310**), the terminal **3** transmits image information designated by a user operation to the image providing server **2**.

In step **312** (S**312**), the image providing server **2** calculates, for each piece of image information, a difference amount indicating a difference between designated image information and other image information.

In step **314** (S**314**), the image providing server **2** transmits image provision information to the terminal **3**.

In step **316** (S**316**), the terminal **3** displays image information on the output device **148** based on the image provision information.

Moreover, when time limit is selected as restrictive condition information, the processing times of S**310** to S**316** are to be limited.

In step **318** (S**318**), the terminal **3** transmits an identifier of image information selected by the user to the image providing server **2**.

In step **320** (S**320**), the image providing server **2** transmits detailed image data corresponding to the image identifier from the terminal **3** to the terminal **3**.

In step **322** (S**322**), the terminal **3** displays detailed image data on the output device **148**.

While the first embodiment and the second embodiment described above have been arranged such that an analytical precision calculating module, an image analyzing module, and an image providing module exist in any one of the image providing server **2** and the terminal **3**, an arrangement is also possible in which the modules respectively exist in separate nodes (the same logic also applies to the respective embodiments to be described below).

For example, an arrangement is also possible in which an analytical precision calculating module and an image analyzing module exist in the image providing server **2** and an image providing module exists in the terminal **3**.

### Third Embodiment

Next, a third embodiment of the disclosure of the present application will be described.

A program that is substantially the same as the image providing server program **20** described earlier is to be executed at an image providing server **2** according to the third embodiment.

[Terminal Program **50**]

FIG. **14** is a diagram illustrating a third terminal program **50** to be executed at the terminal **3** illustrated in FIGS. **1** and **3**.

As illustrated in FIG. **14**, the third terminal program **50** includes a communication processing unit **300**, a UI **302**, an image storing module **32**, an detection precision calculating module **52**, a detecting module **54**, an image providing module **56**, an image selecting unit **392**, and a detailed image display processing unit **394**.

Using these components, the terminal program **50** calculates a detection precision for detecting a detection target from each piece of image information so as to satisfy a designated restrictive condition, performs image processing on each piece of image information based on the calculated detection precision, and detects a projection (detection target) of a designated object from an image corresponding to each piece of image information.

In addition, the terminal program **50** arranges the respective pieces of image information depending on the number of detected objects.

In this case, a "projection" refers to a picture of an object projected in an image.

For example, in the case of an image corresponding to a photograph in which a person and a building are taken together, a “projection” of the person and a “projection” of the building are projected onto the “image”.

In other words, a “projection” is to be included in an “image”. An “image” (for example, a photograph) is made up of one or more “projections” (for example, a projection of a person and a projection of a building).

The detection precision calculating module **52** is made up of a restrictive condition inputting unit **522**, a detection precision calculating unit **524**, a processing capacity detecting unit **526**, and an image-count detecting unit **528**.

Using these components, the detection precision calculating module **52** calculates a detection precision that satisfies a designated restrictive condition.

The detecting module **54** is made up of an image information acquiring unit **542**, an object name inputting unit **544**, an object detecting unit **546**, and an object-count calculating unit **548**.

Using these components, the detecting module **54** detects a projection of a designated object from each image based on the calculated detection precision, and calculates the number of projections of the designated object included in each image.

The image providing module **56** is made up of an image sequence creating unit **562** and an image provision processing unit **564**.

Using these components, the image providing module **56** arranges the respective pieces of image information according to the number of detected objects and provides a list of arranged images as a search result.

In the same manner as the restrictive condition inputting unit **342** of the terminal program **30**, the restrictive condition inputting unit **522** in the detection precision calculating module **52** performs processing so as to display a screen to be used by a user to input the restrictive condition described earlier on the output device **148** that is a liquid crystal screen or the like via the UI unit **302**, and to enable input of a restrictive condition using the input device **146** that is a numerical keypad or the like.

In addition, the restrictive condition inputting unit **522** outputs restrictive condition information inputted by a user operation to the detection precision calculating unit **524**.

In the same manner as the processing capacity detecting unit **346** of the terminal program **30**, by accessing the CPU **140**, the memory **142**, and the like, the processing capacity detecting unit **526** detects a current processing capacity of the terminal **3**.

In addition, the processing capacity detecting unit **526** outputs processing capacity information to the detection precision calculating unit **524**.

In the same manner as the image-count detecting unit **348** of the terminal program **30**, the image-count detecting unit **528** acquires the number of pieces of image information stored in the image DB **326**, and outputs the number of pieces of image information to the detection precision calculating unit **524**.

The detection precision calculating unit **524** uses the accepted restrictive condition information, processing capacity information, and image-count information to calculate a detection precision necessary for detecting an object.

In addition, the detection precision calculating unit **524** outputs the calculated detection precision to the detecting module **54**.

In this case, a detection precision refers to a degree of accuracy when detecting a projection of a designated object from an image. While a higher detection precision results in a

higher degree of accuracy at which a projection of a designated object is detected, throughput also increases and the time necessary for processing increases as well.

Furthermore, a detection precision includes a precision of image processing required when detecting a projection of a designated object from an image.

In the same manner as the image information acquiring unit **362** of the terminal program **30**, the image information acquiring unit **542** in the detecting module **54** acquires image information from the image information managing unit **324**.

The object name inputting unit **544** performs processing so as to display a screen to be used by the user to designate an object name (for example, “person”, “vehicle”, “tree”, “building”, or the like) by input or selection on the output device **148** that is a liquid crystal screen or the like via the UI unit **302**, and to enable designation of an object name using the input device **146** that is a numerical keypad or the like.

In addition, the object name inputting unit **544** outputs an object name designated by a user operation to the object detecting unit **546**.

Based on the detection precision from the detection precision calculating module **52**, the object detecting unit **546** performs image processing necessary for detecting, from an image, a projection of an object corresponding to the designated object name on each piece of image information acquired by the image information acquiring unit **542**.

In addition, based on the detection precision from the detection precision calculating module **52**, the object detecting unit **546** detects a projection of the designated object from each image subjected to image processing.

The object detecting unit **546** may be arranged so as to store several object patterns and to detect a projection of an object by collating the object patterns with each image.

Furthermore, when detecting a projection of a person, a determination of detection of a projection of a person may be made when a face is detected.

Based on a detection result of the object detecting unit **546**, for each piece of image information, the object-count calculating unit **548** calculates the number of projections of a designated object included in an image of the image information, and outputs the numbers of objects corresponding to each piece of image information to the image providing module **56**.

In the image providing module **56**, the image sequence creating unit **562** creates image sequence information so that the respective pieces of image information are arranged in a descending order of the numbers of objects, and outputs the image sequence information to the image provision processing unit **564**.

Based on the image sequence information, the image provision processing unit **564** performs processing necessary for displaying image information on the output device **148** that is a liquid crystal display screen or the like.

Due to the processing by the image provision processing unit **564**, image information is arranged and displayed on the display screen in order of descending prevalence of an object designated by the user in the images of the image information.

Hereinafter, overall processing of the third terminal program **50** will be described.

FIG. **15** is a flowchart (**S40**) illustrating processing of the third terminal program **50** illustrated in FIG. **14**.

As illustrated in FIG. **15**, in step **400** (**S400**), the restrictive condition inputting unit **522** accepts restrictive condition information (time limit, power consumption, display screen size, or the like) inputted by a user operation.

In step **402** (S402), the image-count detecting unit **528** detects the number of pieces of image information stored in the image DB **326**.

In step **404** (S404), by accessing the CPU **140**, the memory **142**, and the like, the processing capacity detecting unit **526** detects a current processing capacity of the terminal **3**.

In step **406** (S406), the detection precision calculating unit **524** calculates a detection precision necessary for detecting an object from an image.

In step **408** (S408), the object name inputting unit **544** accepts an object name inputted by a user operation.

In step **410** (S410), the object detecting unit **546** detects a projection of an object corresponding to a designated object name.

In step **412** (S412), the object-count calculating unit **548** calculates, for each piece of image information, the number of projections of the designated object included in an image of the image information.

In step **414** (S414), due to the processing by the image provision processing unit **564**, image information is arranged and displayed on the display screen in order of descending prevalence of the object designated by the user in the images of the image information.

For example, when "person" is selected as an object name, image information is arranged in descending order of the number of persons projected in the images.

Moreover, when time limit is selected as restrictive condition information, the processing times of S408 to S414 are to be limited.

In step **416** (S416), the object name inputting unit **544** determines whether a change to the object name by a user operation has been accepted or not.

If a change has been accepted, processing returns to S408, and if not, processing proceeds to S418.

In step **418** (S418), a determination is made on whether or not image information has been selected by a user operation.

If image information has been selected, processing proceeds to S422. If not, processing returns to S416.

In step **420** (S420), the detailed image display processing unit **394** causes detailed image data of the selected image to be displayed on the output device **148**.

In step **422** (S422), a determination is made on whether or not the restrictive condition, the number of images, and the current processing capacity of the terminal have been changed.

If it is determined that a change has been made, processing returns to S400. If not, processing is terminated.

Moreover, an arrangement is also possible in which the object detecting unit **524** sets a plurality of objects in advance as objects that are detection targets, and after a detection precision is calculated by the detection precision calculating unit **524**, projections of each object is detected from each image for all set objects before the object name inputting unit **544** accepts an object name (the same logic also applies to other embodiments to be described below).

In this case, the object-count calculating unit **548** may calculate, for each piece of image information, the number of projections of each of the set plurality of objects included in each image, and when an object name is inputted, the image sequence creating unit **562** may create image sequence information according to the inputted object (the same logic also applies to other embodiments to be described below).

Next, a fourth embodiment of the disclosure of the present application will be described.

[Image Providing Server Program **60**]

FIG. **16** is a diagram illustrating a fourth image providing server program **60** to be executed at the image providing server **2** illustrated in FIGS. **1** and **2** in place of the image providing server program **20**.

As illustrated in FIG. **16**, the fourth image providing server program **60** is made up of a communication processing unit **200**, an image information managing unit **222**, an image database (DB) **224**, a detection precision calculating module **62**, a detecting module **64**, an image providing module **66**, an image selection receiving unit **292**, and a detailed image data transmitting unit **294**.

Using these components, the image providing server program **60** calculates a detection precision so as to satisfy a designated restrictive condition, performs image processing on each piece of image information based on the calculated detection precision, and detects a projection (detection target) of a designated object.

In addition, the image providing server program **60** arranges the respective pieces of image information according to the number of detected objects.

The detection precision calculating module **62** is made up of a restrictive condition inputting unit **622**, a detection precision calculating unit **624**, a processing capacity detecting unit **626**, and an image-count detecting unit **628**.

Using these components, the detection precision calculating module **62** calculates a detection precision that satisfies a designated restrictive condition.

The detecting module **64** is made up of an image information acquiring unit **642**, an object name receiving unit **644**, an object detecting unit **646**, and an object-count calculating unit **648**.

Using these components, the detecting module **64** detects a projection of a designated object from each image based on the calculated detection precision, and calculates the number of projections of the designated object included in each image.

The image providing module **66** is made up of an image sequence creating unit **662** and an image provision information transmitting unit **664**.

Using these components, the image providing module **66** arranges the respective pieces of image information according to the number of detected objects and provides the terminal **3** with a list of arranged images as a search result.

In the detection precision calculating module **62**, the restrictive condition inputting unit **622** receives restrictive condition information regarding a restrictive condition designated by a user from the terminal **3** via the network **100** and the communication processing unit **200**, and outputs the restrictive condition information to the detection precision calculating unit **624**.

By accessing the CPU **140**, the memory **142**, and the like of the terminal **3**, the processing capacity detecting unit **626** detects a current processing capacity of the terminal **3**.

In addition, by accessing the CPU **140**, the memory **142**, and the like of the image providing server **2**, the processing capacity detecting unit **626** detects a current processing capacity of the image providing server **2**.

Furthermore, the processing capacity detecting unit **626** checks the communication state between the image providing server **2** and the terminal **3** and detects a current communication capacity (data transmission speed or the like) of the network **100** or the like.



Moreover, the processing capacity detecting unit 626 outputs information (processing capacity information) regarding the detected processing capacities to the detection precision calculating unit 624.

The image-count detecting unit 628 outputs a signal for detecting the number of pieces of image information stored in the image DB 224 to the image information managing unit 222.

The detection precision calculating unit 624 uses the accepted restrictive condition information, processing capacity information, and image-count information to calculate a detection precision necessary for detecting an object.

In addition, the detection precision calculating unit 624 outputs the calculated detection precision to the detecting module 64.

In the detecting module 64, the image information acquiring unit 642 acquires image information from the image information managing unit 222.

The object name receiving unit 644 receives an object name designated by the user from the terminal 3 via the network 100 and the communication processing unit 200, and outputs the object name to the object detecting unit 646.

In the same manner as the object detecting unit 546 of the terminal program 50, based on the detection precision from the detection precision calculating module 62, the object detecting unit 646 performs image processing necessary for detecting, from an image, a projection of an object corresponding to the designated object name on each piece of image information acquired by the image information acquiring unit 642.

In addition, based on the detection precision from the detection precision calculating module 62, the object detecting unit 646 detects a projection of the designated object from each image subjected to image processing.

In the same manner as the object-count calculating unit 548 of the terminal program 50, based on a detection result of the object detecting unit 646, for each piece of image information, the object-count calculating unit 648 calculates the number of projections of a designated object included in an image of the image information, and outputs the number of objects corresponding to each piece of image information to the image providing module 66.

In the same manner as the image sequence creating unit 562 of the terminal program 50, the image sequence creating unit 662 in the image providing module 66 creates image sequence information so that the respective pieces of image information are arranged in a descending order of the numbers of objects, and outputs the image sequence information to the image provision processing unit 564.

Based on the image sequence information from the image sequence creating unit 662, the image provision information transmitting unit 664 performs processing necessary for providing image information to the output device 148 that is a liquid crystal display screen or the like of the terminal 3.

In addition, the image provision information transmitting unit 664 transmits image provision information generated by the processing described above to the terminal 3 via the communication processing unit 200 and the network 100. [Terminal Program 68]

FIG. 17 is a diagram illustrating a fourth terminal program 68 to be executed at the terminal 3 illustrated in FIGS. 1 and 3 in place of the terminal program 50.

As illustrated in FIG. 17, the fourth terminal program 68 is made up of a communication processing unit 300, a UI 302, a processing capacity detection receiving unit 412, a processing capacity detecting unit 414, a processing capacity information transmitting unit 416, a restrictive condition inputting

unit 422, a restrictive condition transmitting unit 424, an object name inputting unit 682, an object name transmitting unit 684, an image provision information receiving unit 686, an image display processing unit 688, an image selection inputting unit 452, an image selection transmitting unit 454, a detailed image data receiving unit 460, and a detailed image display processing unit 462.

In the terminal program 68, the object name inputting unit 682 performs processing so as to display a screen to be used by the user to input an object name on the output device 148 that is a liquid crystal screen or the like via the UI unit 302, and to enable designation of an object name using the input device 146 that is a numerical keypad or the like.

In addition, the object name inputting unit 682 outputs an object name selected by a user operation to the object name transmitting unit 684.

The object name transmitting unit 684 transmits the object name selected by the user to the image providing server 2 via the network 100 and the communication processing unit 300.

The image provision information receiving unit 686 receives image provision information from the image providing server 2 via the network 100 and the communication processing unit 300, and outputs the image provision information to the image display processing unit 686.

Based on the image provision information from the image display processing unit 686, the image display processing unit 688 performs processing necessary for displaying image information on the output device 148 that is a liquid crystal display screen or the like.

The image information to be displayed may be image names of image information or thumbnails of image data.

[Overall Operations of Image Display System 1]

Hereinafter, overall operations of the image display system 1 according to the fourth embodiment will be described.

FIG. 18 is a communication sequence diagram illustrating overall operations (S50) of the image display system 1 according to the fourth embodiment.

As illustrated in FIG. 18, in step 500 (S500), the terminal 3 transmits restrictive condition information to the image providing server 2.

In step 502 (S502), the image providing server 2 detects current processing capacities of the terminal 3 and the image providing server 2 and a current communication capacity of a communication channel such as the network 100.

In step 504 (S504), the image providing server 2 calculates a detection precision based on the restrictive condition information and current processing capacities.

In step 506 (S506), the terminal 3 transmits an object name inputted by a user operation to the image providing server 2.

In step 508 (S508), the image providing server 2 detects a projection of an object corresponding to the designated object name from each image, and for each piece of image information, calculates the number of projections of the designated object included in the image of the image information.

In step 510 (S510), the image providing server 2 transmits image provision information to the terminal 3.

In step 512 (S512), the terminal 3 displays image information on the output device 148 based on the image provision information.

Moreover, when time limit is selected as restrictive condition information, the processing times of S506 to S512 are to be limited.

The embodiments described above have been presented by way of exemplification and illustration and do not encompass all possible embodiments of the disclosure of the present application.

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In addition, the embodiments described above are not intended to limit the technical scope of the disclosure of the present application to the contents of the disclosure, and various changes and modifications can be made in light of the contents of the disclosure.

Furthermore, since the embodiments described above have been selected and described in order to best illustrate the principles disclosed and its practical applications, based on the contents of the disclosure of the embodiments, one skilled in the art can best utilize the disclosure of the present application and embodiments thereof with various modifications as are suited to all particular uses contemplated.

Moreover, it is intended that the technical scope of the disclosure of the present application be defined by the claims and equivalents thereof.

## INDUSTRIAL APPLICABILITY

The disclosure of the present application can be utilized for displaying images.

## DESCRIPTION OF SYMBOLS

1 image display system  
 100 network  
 102 base station  
 104 GPS satellite  
 2 image providing server  
 120 communication processing unit  
 140 CPU  
 142 memory  
 144 peripheral  
 146 input device  
 148 output device  
 152 recording apparatus  
 154 recording medium  
 3 terminal  
 150 camera  
 160 GPS  
 20 image providing server program  
 200 communication processing unit  
 202 user interface unit (UI)  
 204 image receiving unit  
 206 image information managing unit  
 208 image database (DB)  
 210 image inputting unit  
 212 image request receiving unit  
 214 image transmitting unit  
 22 second image providing server program  
 200 communication processing unit  
 222 image information managing unit  
 224 image database (DB)  
 24 analytical precision calculating module  
 242 restrictive condition receiving unit  
 244 image analytical precision calculating unit  
 246 processing capacity detecting unit  
 248 image-count detecting unit  
 26 image analyzing module  
 260 image component extracting unit  
 264 color classifying unit  
 266 color percentage calculating unit  
 262 image information acquiring unit  
 28 image providing module  
 280 image component receiving unit  
 282 image designation receiving unit  
 284 difference calculating unit  
 286 image sequence creating unit

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288 image provision information transmitting unit  
 292 image selection receiving unit  
 294 detailed image data transmitting unit  
 60 fourth image providing server program  
 5 62 detection precision calculating module  
 622 restrictive condition inputting unit  
 624 detection precision calculating unit  
 626 processing capacity detecting unit  
 628 image-count detecting unit  
 10 64 detecting module  
 642 image information acquiring unit  
 644 object name receiving unit  
 646 object detecting unit  
 648 object-count calculating unit  
 15 66 image providing module  
 662 image sequence creating unit  
 664 image provision information transmitting unit  
 30 terminal program  
 300 communication processing unit  
 20 302 UI  
 32 image storing module  
 320 image acquiring unit  
 322 camera processing unit  
 324 image information managing unit  
 25 326 image DB  
 34 analytical precision calculating module  
 342 restrictive condition inputting unit  
 344 image analytical precision calculating unit  
 346 processing capacity detecting unit  
 30 348 image-count detecting unit  
 36 image analyzing module  
 360 image component extracting unit  
 364 color classifying unit  
 366 color percentage calculating unit  
 35 368 metadata acquiring unit  
 362 image information acquiring unit  
 38 image providing module  
 380 image component selecting unit  
 382 image designating unit  
 40 384 difference calculating unit  
 386 image sequence creating unit  
 388 image provision processing unit  
 392 image selecting unit  
 394 detailed image display processing unit  
 45 40 second terminal program  
 412 processing capacity detection receiving unit  
 414 processing capacity detecting unit  
 416 processing capacity information transmitting unit  
 422 restrictive condition inputting unit  
 50 424 restrictive condition transmitting unit  
 430 image component inputting unit  
 432 image component transmitting unit  
 436 image designation inputting unit  
 438 image designation transmitting unit  
 55 442 image provision information receiving unit  
 444 image display processing unit  
 452 image selection inputting unit  
 454 image selection transmitting unit  
 460 detailed image data receiving unit  
 60 462 detailed image display processing unit  
 50 third terminal program  
 52 detection precision calculating module  
 522 restrictive condition inputting unit  
 524 detection precision calculating unit  
 65 526 processing capacity detecting unit  
 528 image-count detecting unit  
 54 detecting module

- 542 image information acquiring unit
- 544 object name inputting unit
- 546 object detecting unit
- 548 object-count calculating unit
- 56 image providing module
- 562 image sequence creating unit
- 564 image provision processing unit
- 68 fourth terminal program
- 682 object name inputting unit
- 684 object name transmitting unit
- 686 image provision information receiving unit
- 688 image display processing unit

The invention claimed is:

1. An image display system comprising:
  - an image display apparatus; and
  - an image providing apparatus that provides the image display apparatus with one or more pieces of image information which may respectively include one or more projections of a person as a detection target, wherein the image providing apparatus includes:
    - a calculating module that calculates a detection precision for detecting the detection target from the image information so as to satisfy a restrictive condition designated for the provision of the one or more pieces of image information based on current processing capacities of the image display apparatus and the image providing apparatus, a current communication processing capacity between the image display apparatus and the image providing apparatus, and an amount of information corresponding to the number of the one or more pieces of image information;
    - a detecting module that receives a designation of the kind of a detection target and detects the detection target from each of the one or more pieces of image information at the calculated detection precision, the detecting module detecting, when a projection of a person is designated as the detection target, the projection of the person from an image related to each of the one or more pieces of image information and calculating the number of designated detection targets included in the image information; and
    - a providing module that arranges the one or more pieces of image information in descending order of the calculated number to create provision information, the image display apparatus displays the provision information and image information included in the provision information,
    - the restrictive condition is designated from any of time, power consumption, and display screen size, and when time is designated as the restrictive condition, the calculating module calculates the detection precision such that the period of time from the moment the detecting module receives a designation of a detection target to the moment the image display apparatus displays the provision information is equal to or within the designated time.
2. An image display apparatus that displays one or more pieces of image information which may respectively include one or more detection targets, the image display apparatus comprising:
  - a calculating module that calculates a detection precision for detecting the detection target from the image information so as to satisfy a restrictive condition designated for the provision of the one or more pieces of image information;
  - a detecting module that receives a designation of the kind of a detection target, detects a detection target of the designated kind from each of the one or more pieces of

- image information at the calculated detection precision, and calculates the number of detection targets of the designated kind which are included in the image information; and
- a providing module that creates and displays provision information in which the one or more pieces of image information are arranged in descending order of the calculated number,
  - wherein, when time is designated as the restrictive condition, the calculating module calculates the detection precision such that the period of time from the moment the detecting module receives a designation of a detection target to the moment the image display apparatus displays the provision information is equal to or within the designated time.
- 3. The image display apparatus according to claim 2, wherein
  - the calculating module calculates the detection precision based on a current processing capacity of the image display apparatus.
- 4. The image display apparatus according to claim 2, wherein
  - the calculating module calculates the detection precision based on an amount of information corresponding to the number of the one or more pieces of image information.
- 5. The image display apparatus according to claim 2, wherein
  - the restrictive condition is designated from any of time, power consumption, and display screen size.
- 6. The image display apparatus according to claim 2, wherein
  - the detection target includes a projection of a person, and the detecting module detects, when a projection of a person is designated as a detection target, the projection of the person from images related to each of the one or more pieces of image information.
- 7. An image display system comprising:
  - an image display apparatus, and
  - an image providing apparatus that provides the image display apparatus with one or more pieces of image information which may respectively include one or more detection targets, wherein
    - the image providing apparatus includes:
      - a calculating module that calculates a detection precision for detecting the detection target from the image information so as to satisfy a restrictive condition designated for the provision of the one or more pieces of image information;
      - a detecting module that receives a designation of the kind of a detection target, detects the designated detection target from each of the one or more pieces of image information at the calculated detection precision, and calculates the number of designated detection targets which are included in the image information; and
      - a providing module that arranges the one or more pieces of image information in descending order of the calculated number to create provision information,
    - the image display apparatus displays the provision information and image information included in the provision information, and
    - when time is designated as the restrictive condition, the calculating module calculates the detection precision such that the period of time from the moment the detecting module receives a designation of a detection target to the moment the image display apparatus displays the provision information is equal to or within the designated time.

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8. The image display system according to claim 7, wherein the calculating module calculates the detection precision based on current processing capacities of the image display apparatus and the image providing apparatus and a current communication processing capacity between the image display apparatus and the image providing apparatus. 5
9. The image display system according to claim 7, wherein the calculating module calculates the detection precision based on an amount of information corresponding to the number of the one or more pieces of image information. 10
10. The image display system according to claim 7, wherein the restrictive condition is designated from any of time, power consumption, and display screen size. 15
11. The image display system according to claim 7, wherein the detection target includes a projection of a person, and the detecting module detects, when a projection of a person is designated as a detection target, the projection of the person from images related to each of the one or more pieces of image information. 20
12. An image providing apparatus connected to an image display apparatus and which provides the image display apparatus with one or more pieces of image information which may respectively include one or more detection targets, the image providing apparatus comprising: 25
- a calculating module that calculates a detection precision for detecting the detection target from the image information so as to satisfy a restrictive condition designated for the provision of the one or more pieces of image information;
  - a detecting module that receives a designation of the kind of a detection target, detects a detection target of the designated kind from each of the one or more pieces of image information at the calculated detection precision, and calculates the number of detection targets of the designated kind which are included in the image information; and 35
  - a providing module that arranges the one or more pieces of image information to create provision information so that the one or more pieces of image information are displayed in descending order of the calculated number, wherein 40
- when time is designated as the restrictive condition, the calculating module calculates the detection precision such that the period of time from the moment the detecting module receives a designation of a detection target to the moment the image display apparatus displays the provision information is equal to or within the designated time. 45
13. An image display method executed by an image display apparatus, and an image providing apparatus that provides the image display apparatus with one or more pieces of image information 50

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- information which may respectively include one or more detection targets, wherein the image providing method comprises:
- the image providing apparatus calculating a detection precision for detecting the detection target from the image information so as to satisfy a restrictive condition designated for the provision of the one or more pieces of image information;
  - the image providing apparatus receiving a designation of the kind of a detection target, detecting a detection target of the designated kind from each of the one or more pieces of image information at the calculated detection precision, and calculating the number of detection targets of the designated kind which are included in the image information;
  - the image providing apparatus arranging the one or more pieces of image information in descending order of the calculated number to create provision information; and
  - the image display apparatus displaying the provision information and image information included in the provision information, 5
- when time is designated as the restrictive condition, the image providing apparatus calculates the detection precision such that the period of time from the moment of receiving a designation of a detection target to the moment the image display apparatus displays the provision information is equal to or within the designated time.
14. An image display method executed by an image providing apparatus connected to an image display apparatus and which provides the image display apparatus with one or more pieces of image information which may respectively include one or more detection targets, the image display method comprising: 10
- calculating a detection precision for detecting the detection target from the image information so as to satisfy a restrictive condition designated for the provision of the one or more pieces of image information;
  - receiving a designation of the kind of a detection target, detecting a detection target of the designated kind from each of the one or more pieces of image information at the calculated detection precision, and calculating the number of detection targets of the designated kind which are included in the image information; and 15
  - arranging the one or more pieces of image information in descending order of the calculated number to create provision information, wherein 20
- when time is designated as the restrictive condition, the image providing apparatus calculates the detection precision such that the period of time from the moment of receiving a designation of a detection target to the moment the image display apparatus displays the provision information is equal to or within the designated time. 25

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