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TITLE OF THE INVENTION

COLOR IMAGE PROCESSING APPARATUS AND METHOD,
AND COLOR IMAGE OUTPUT APPARATUS

BACKGROUND OF THE INVENTION5 Field of the Invention

The present invention relates to a color image processing apparatus and method, and a color image output apparatus, and more particularly to an apparatus and a method capable of presenting good color reproducibility.

10 Description of the Related Art

(Relating to Color Space)

In output apparatuses such as color printers for printing figures and image data, color data to be
15 handled are designated by RGB values, which are in turn designated by color modes or commands, for figure data, and are provided in the RGB point or frame sequential format for image data. Other than the RGB color space, YMC color spaces (such as depending on ink
20 characteristics) specific to respective printers and XYZ color spaces or the like defined by CIE, etc. are also handled in some cases. In any case, actual printing is performed by making input data subjected in a printer to a color reproduction process (e.g.,
25 conversion from RGB to YMCK) corresponding to a color space defined for the printer when printed.

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Generally, in consideration of color matching between color data handled by a color printer and a different apparatus (e.g., a color scanner or a color display such as CRT), it is often practiced to define
5 one color space as a reference and perform color compensation suited to light emitting (coloring) characteristics for each color processing apparatus. In this case, color processing in the color printer is also executed to be compatible with the color space as
10 a reference so that the color printer can output and reproduce an image displayed by a color display, for example, with good fidelity.

In a system shown in Fig. 1, if various apparatuses are each configured to be able to precisely
15 perform color space conversion and color compensation, it is possible for those apparatuses to handle standardized colors. In an example of Fig. 1, for enabling a color scanner 11, a color display 13 and a color printer 15 to handle the same color data, one
20 color space is defined as a reference and the color data are converted into color spaces specific to the apparatuses by associated color space converters 12, 14, 16. With such a configuration, the apparatuses can handle standardized colors.

25 In practice, however, the apparatuses have different ranges of color reproduction due to their

intrinsic physical characteristics. Although it is difficult to pursue for a colorimetric matching, color compensation for minimizing a color difference by the use of color difference formula represented by CIE 1976
5 $L^*a^*b^*$, for example, is generally practiced in view of the above. Therefore, color printers are also designed to perform color space conversion and color compensation therein so as to print colors as possible as close to those on the color space as a reference
10 when handling color data.

Fig. 2 is a block diagram showing typical data processing executed in a color printer, particularly showing a conversion process from input RGB data into YMC. As shown, data input through a receiving buffer
15 21 are supplied to a data analyzer 22 which analyzes a data type from the data format. In the case of image data, the data are branched to an image developing system 23, converted into YMC data by referring to a color reproduction processor 24, and then applied to a
20 page buffer 26. In the case of computer graphics (CG) data, the data are branched to a CG developing system 25, converted into YMC data by referring to the color reproduction processor 24, and then applied to the page buffer 26 likewise.

25 While many color difference formulae have been proposed for methods of evaluating whether two colors

represented on different media are identical to each other or not, any method has not yet been absolutely established and various methods are employed case by case depending on the purposes of use at the present.

5 Similarly, there are several methods for color reproduction which are also employed case by case depending on the purposes of use. Taking into account color matching, the evaluating method is necessarily different depending on which color reproduction is
10 aimed. In color printers, a color reproducing method executed therein is an important element directly affecting image quality of prints. Generally, as mentioned above, the color difference formula of CIE 1976 $L^*a^*b^*$ or the like is practiced so that color
15 compensation is performed to minimize color differences. This method is effective when color data read by a scanner are reproduced by a color printer, because the original is a reflecting document (i.e., colors represented on paper) and reproducing those
20 colors with ink used in the printer is relatively easy. In other words, as physical coloring mechanisms are basically the same, color reproduction is easier than the case of other media although there are problems of a difference in ink characteristics and ink density
25 (gradation).

However, since colors produced by luminescence on

screens of color displays are different in their physical characteristics per se from colors on a reflecting document, there are limitations in pursuing color reproduction by the use of general color difference formulae. When an image produced by such a display media is a natural picture, a method of color reproduction generally called preferred matching is often employed. This method is based on the concept of achieving good color reproduction for some important colors (e.g., color of the human skin) in an image, apart from whether a reproduced image and an original image have identical colors or not. Such color reproduction is effective in handling data such as a natural image, but a color reproduction process taking no consideration of identity of colors raises a drawback when handling data such as a CG image.

The above problem can be solved if a color reproduction process can be changed in accordance with data to be processed. In conventional color printers, however, the color processing referred in an internal developing process to produce a final output is fixed regardless of data to be handled, as shown in Fig. 2. Color printers are usually designed with a mind to achieve identity of colors. Accordingly, when data to be processed is a natural image, it was impossible to execute a different color reproduction process such as

preferred matching.

The above-mentioned problems can also be thought below from another aspect.

Generally, in output apparatuses for forming an
5 image based on color visual data input thereto, a
difference in color reproduction range between the
input side and the output apparatus is caused as a
problem during a process of color reproduction. A CRT
monitor or the like is a luminescent device in which
10 light source colors RGB are mixed in an additive manner
to carry out color reproduction. On the other hand, a
printer or the like is a device in which ink colors
YMCK are mixed in a subtractive manner to carry out
color reproduction. Such a difference in the color
15 reproducing manners results in different color
reproduction ranges between the monitor and the printer
and, usually, the monitor has a larger color
reproduction range.

Fig. 8A shows how the color reproduction ranges
20 are different from each other. Denoted by 80 in Fig.
8A is a color space which is theoretically conceivable
in accordance with standards such as NTSC using an
 $L^*a^*b^*$ uniform color space, i.e., a color space which
input data from a host computer can take. 81 is a
25 color reproduction range of a monitor and 82 is a color
reproduction range of a printer.

When an input color image is produced by an output apparatus, those colors which are outside a color reproduction range of the output apparatus are required to be made correspond to suitable colors in the color reproduction range. This is generally called color space compression. A conventional output apparatus incorporates only one kind of method for the color space compression or no methods, and the color space compression is performed on the host computer side.

10 There have generally been practiced several methods for the color space compression. These methods will now be described with reference to Figs. 8A to 8D on an assumption that the color reproduction range of a monitor is converted into the color reproduction range of a printer.

15 In Fig. 8A, 83, 84 indicate the brightest colors (white points) in the respective color reproduction ranges of the monitor and the printer, whereas 85, 86 indicate the darkest colors (black points).

20 The first compressing method is performed by, as shown by a dot line in Fig. 8B, mapping the white and black points of the monitor to the white and black points of the printer, respectively, and then converting other colors while keeping the relative relationship to the white and black points. Thus, the conversion is made so that a figure indicated by the

dot line is similar to the color reproduction range 81.
This method is suitable for processing image data such
as a photograph including many colors.

5 The second compressing method is performed by, as
shown in Fig. 8C, mapping colors of the monitor to an
outer edge of the color reproduction range of the
printer without changing L^* (luminosity). This method
is suited to reproduce colors with high fidelity as
desired for logo marks or the like (i.e., spot colors).

10 The third compressing method performs the
compression by sacrificing luminosity to some extent
without changing saturation as possible as practicable,
as shown in Fig. 8C. This method is suitable for CG or
the like.

15 Thus, since optimum methods for color space
compression are different depending on the types of
input data such as image data, spot colors and CG, it
is desired to selectively employ any one of the
compressing methods in conformity with the purpose.

20 As mentioned before, however, a conventional
output apparatus incorporates, at best, only one kind
of method for the color space compression, and cannot
realize selective use of the above compressing methods
depending on the types of input data. This leads to a
25 difficulty in carrying out optimum color reproduction.

Further, an attempt of designing a host computer

to select any one of the color space compressing
methods and execute a compression process would result
in a drawback of increasing a burden imposed on the
host computer to execute the compression process and
5 degrading performance of the entire system.

A concern of the present invention is to solve all
or some of the drawbacks mentioned above.

An embodiment of the present invention
10 provides a color image processing apparatus, a color
image processing method and a color image output
apparatus, which can satisfactorily reproduce a natural
image or the like.

Another embodiment of the present invention
15 provides a color image processing apparatus, a color
image processing method and a color image output
apparatus, which enables precise color reproduction for
an CG image or the like.

In accordance with a
20 preferred embodiment of the present invention, there is
disclosed an apparatus comprising input means for
receiving visual data from an external apparatus,
analyzing means for analyzing the input data received
by the input means, data developing means for
25 developing the input data into output data in
accordance with a result analyzed by the analyzing

means, and including color processing means which executes color processing on the input data, storage means for storing a plurality of color processing methods to be executed by the color processing means in
5 the data developing means, select means for selecting one of the plural color processing methods stored in the storage means, and output means for outputting the data having been developed by the developing means to be adapted for output.

10 Yet another concern of the present invention is to provide a color image processing apparatus which is suitably built in apparatus having a printing function.

Further concerns, features and advantages of the present invention will be apparent from the following
15 detailed description of embodiments of the present invention with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing the configuration of a system for carrying out space color
20 conversion for each of apparatuses.

Fig. 2 is a block diagram showing a typical process of color space conversion in a color printer.

Fig. 3 is a block diagram showing a process of color space conversion in a color printer according to
25 one embodiment of the present invention.

Fig. 4 is a graph indicating a characteristic of

gradation.

Fig. 5 is a graph indicating a color shift based on an HLS color representation system.

Fig. 6 is a diagram showing a weighting step in a
5 color reproduction process.

Fig. 7 is a block diagram of a color printer according to a modified embodiment.

Figs. 8A to 8D are conceptual diagrams for explaining color reproduction ranges and color space
10 compression.

Fig. 9 is a block diagram showing one example of a control circuit for use in an output apparatus according to a second embodiment of the present invention.

15 Fig. 10 is a flowchart showing an output process for one page in the second embodiment.

Fig. 11 is a flowchart showing color processing in the second embodiment.

Fig. 12 is a flowchart showing color processing in
20 a third embodiment according to the present invention.

Fig. 13 is a diagram showing one example of an image to be processed in the third embodiment.

Figs. 14A and 14B are diagrams showing one example of an input command string in the third embodiment.

25 Fig. 15 is a diagram showing one example of data in an intermediate format in the third embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[First Embodiment]

A first embodiment of the present invention will hereinafter be described in detail with reference to
5 the attached drawings.

The following description is made in connection with an embodiment in which the invention is applied to a color reproduction process executed inside a color printer.

10 <Outline of color printer>

Fig. 3 is a block diagram showing a main internal process concerned with color processing executed in a color printer according to this embodiment. As shown, input data are first temporarily recorded in a
15 receiving buffer 31 and then supplied to a data analyzer 32 which analyzes a data type from the data format. When the input data are image data, a pixel size and RGB values for each pixel are arrayed in a point sequential format. When the input data are CG
20 data, data indicating a figure type and coordinate values of the figure, RGB data as color designating values, etc. are arrayed in a format compatible with the associated processing system. After analyzing whether the input data are image data or CG data by the
25 data analyzer 32, the process is branched to a developing system corresponding to the data type. More

specifically, when processing image data, the data are branched to an image developing system 33 from the data analyzer 32, converted into YMC data by referring to a color reproduction processor 34, and then applied to a
5 page buffer 37. When processing CG data, the data are branched to a CG developing system 35 from the data analyzer 32, converted into YMC data by referring to a color reproduction processor 36, and then applied to the page buffer 37.

10 <Outline of color reproduction process>

The difference between the color reproduction processors 34 and 36 will be described below. The color reproduction processor 34 is to execute a color reproduction process with much care paid to identity of
15 colors, and is designed to output a color image sample, read the output color sample, make both a color of the read sample and a color to be output from the system 33 subjected to colormetry, and minimize a difference between both results of the colormetry, i.e., a color
20 difference, over an entire color space. On the other hand, the color reproduction processor 36 is designed to execute a color reproduction process with care paid to preferred matching, such that an important color in a natural image or the like (e.g., skin color) develops
25 satisfactorily.

Note that the term "preferred matching" used

herein includes, rather than the above color matching made over an entire color space, any other color matching such as made to provide satisfactory coloring of a particular color, for example. This example will
5 be described later with reference to Figs. 8A to 8D.

<Outline of preferred matching>

For the color reproduction processor 34, it is designed to minimize a color difference between each pair of the sampled color and the color to be output
10 over a color space as a whole and, therefore, its purpose is clear. A description will now be given on the specific purpose of the preferred matching carried out in the color reproduction processor 36.

As a result of the inventor studying color
15 spectrum distribution in a natural image, it has been found that most data belong to an intermediate gradation zone, and those data which are distributed near very low and very high gradation zones are little. Also, if a natural image includes the latter data, such
20 an image is no more than an unnatural image in many cases. Therefore, it is thought to execute the process in which importance is attached to color reproduction near the intermediate gradation zone, while sacrificing the data near the low and high gradation zones. This
25 method is effective particularly in the case of handling, for example, a binary image of which

gradation representing ability is not so high, and also presents a merit of improving gradation by using the zone which provides color reproduction as good as possible.

- 5 As seen from an example shown in Fig. 4, the curve indicated by a solid line has a larger slope than the straight line indicated by a dot line in the intermediate gradation zone defined by R1 and R2, meaning that image gradation can be reproduced
- 10 satisfactorily. Executing the above process inevitably causes a color shift as shown in Fig. 5. Fig. 5 shows movement of a point p to a point p' on an HLS color representation system (polar coordinate system in which L indicates a vertical axis, H an angle from the
- 15 reference line, and S a distance from the origin). The shift amount is expressed by three variables of dH, dL and dS shown in the drawing. While identity of colors is not necessarily required to be considered and some color shift is allowed in the case of preferred
- 20 matching, there also would arise a problem if the color shift occurs in a large amount. Therefore, the color reproduction process is designed here to keep a value of delta E in the color difference formula of CIE 1976 $L^*a^*b^*$ within "20".
- 25 Further, as to color patch data prepared in determining masking parameter, several colors which

regarded to be important for a natural image, such as a skin color, are also operated to have better characteristics in the color reproduction process by increasing values of weighting for those colors. As
5 shown in Fig. 6, the weighting values are increased by employing usual color patches which are dividing a color space uniformly.

Fig. 7 shows a modified embodiment in which a contour emphasizing process is additionally executed in
10 the processing of image data.

Input data are first temporarily recorded in a receiving buffer 71 and then supplied to a data analyzer 72 which analyzes a data type from the data format. When the input data are image data, a pixel
15 size and RGB values for each pixel are arrayed in a point sequential format. When the input data are CG data, data indicating a figure type and coordinate values of the figure, RGB data as color designating values, etc. are arrayed in a format compatible with
20 the associated processing system. After analyzing whether the input data are image data or CG data by the data analyzer 72, the process is branched to a developing system corresponding to the data type. More specifically, when processing image data, the data are
25 branched to an image developing system 73 from the data analyzer 72, converted into YMC data by referring to a

color reproduction processor 74, and then applied to a
page buffer 78 through a contour emphasizing process
77. When processing CG data, the data are branched to
a CG developing system 75 from the data analyzer 72,
5 converted into YMC data by referring to a color
reproduction processor 76, and then applied to the page
buffer 78. The process executed by each color
reproduction processor is the same as that in the above
embodiment and hence will not be described here.

10 In the contour emphasizing process 77, an image is
scanned in each of horizontal and vertical directions
to extract, as its contour, those portions where pixel
values are abruptly changed, and then modify the pixel
values so that their change rate are increased, thereby
15 providing sharper image quality to clearly represent
the contour portions. Note that the contour
emphasizing process itself is well known and hence its
detailed description is omitted here.

Thus, with this embodiment, since an optimum color
20 reproduction process corresponding to each data type is
automatically selected in a color printer, improved
image quality can be obtained in printing of a natural
image and, at the same time, no drawbacks are caused in
color reproduction of a CG image or the like, even when
25 a standardized color space is used for data of various
images.

This embodiment may be applied to a system comprising a plurality of units or an apparatus comprising one unit. It is needless to say that this embodiment is also applicable to the case where the
5 intended processing is achieved by loading a program into the system or apparatus.

According to this embodiment, as described above, by selecting a color reproduction process corresponding to data to be handled, the data can be printed with
10 more satisfactory image quality.

[Second Embodiment]

A second embodiment of the present invention will hereinafter be described in detail with reference to the attached drawings.

15 The following description is made in connection with a color printer of bubble-jet (BJ) type, but it is a matter of course that the invention can also similarly applicable to any other output apparatuses such as color printers of other types and color
20 monitors.

In this embodiment, an output apparatus comprises an input unit for receiving visual data containing data in a command format for output control, image data and so on which are delivered from an external apparatus,
25 an analyzer for analyzing the input data received by the input unit, developing unit for developing the

input data into output data in accordance with a result
analyzed by the analyzing unit, color processor
constituting a part of the developing unit and
executing color processing such as color space
5 compression on the input data during the development
made by the developing unit, storage for storing a
plurality of color processing methods, and selector for
selecting one of the plural color processing methods
stored in the storage. When the input data received
10 from the external apparatus are developed by the
developing unit into the output data, one of the plural
color processing methods stored in the storage is
selected by the selector in accordance with the
analyzed result of the input data by the analyzer, and
15 the color processing unit executes the color processing
in accordance with the selected color processing
method. With such an arrangement, color space
compressing methods can selectively be used in the
output apparatus depending on the input visual data,
20 which enables optimum color reproduction without
increasing a load imposed on a host computer.

The second embodiment will be described below in
more detail.

Fig. 9 is a block diagram showing one example of a
25 control circuit constituting a part of an output
apparatus according to the second embodiment of the

present invention. In Fig. 9, denoted by 101 is an output apparatus of this embodiment and 102 is an external apparatus such as a host computer or terminal apparatus.

5 In the output apparatus 101, denoted by 111 is an input unit which receives data transferred from the host computer 102. 112 is an analyzer which analyzes the input data received by the input unit 111 and forms data in an intermediate format to be used in a later-
10 described developing unit 113. The intermediate format data will be described later.

 Denoted by 113 is a developing unit which executes various processes based on the intermediate format data prepared by the analyzer 112 for conversion into output
15 data to be used by a later described output unit. 114 is a color processor which is incorporated in the developing unit 113 to especially execute color processing. The term "color processing" means, for example, a process of finally converting input data in
20 RGB representation from a monitor into data in CMYK representation which constitute color signals to be output from a printer, and includes a process of color space compression executed to compensate for the difference in color reproduction range between the
25 monitor and the printer which difference is produced during the conversion, as explained before.

Denoted by 115 is a selector which selects and takes, from a later-described color processing method storage, one of the color processing methods for use in the color processing by the color processor 114. 116 is a color processing method storage which stores a plurality of color processing methods to be used by the color processor 114 for the color processing. 117 is an output unit which forms an output image by using the output data from the developing unit 113. The output data used in the output unit are data in a bit map format for one page and prepared respectively for CMYK four colors. The output unit 117 delivers the output data to a BJ head for printing an image on print paper by using ink in colors of C (cyan), M (magenta), Y (yellow) and K (black).

A description will now be given on processing steps in the control circuit of this embodiment arranged as explained above, with reference to flowcharts shown in Figs. 10 and 11. Fig. 10 shows processing steps executed by the output apparatus 101 when it receives data for one page from the host computer 102 and forms output data.

First, in step S20, the input unit 11 receives data for one page from the host computer 102. An exemplary image of one page to be output through the processing is shown in Fig. 13. Referring to Fig. 13,

denoted by 50 a text portion comprised of character strings, 51 is a portion of full-color image data resulted from scanning a photograph, 52 is a portion comprising registered characters such as logo marks
5 which are colored in accordance with the registered numbers, i.e., the designated spot colors, and 53 is a portion of CG data such as a pi chart selectively colored.

More specifically, the host computer 102 converts
10 an image on a monitor, including various forms as shown in Fig. 13, into input visual data adapted to be produced from the output unit 101 and then delivers the converted data. In this case, the input data include various commands and data necessary for forming output
15 data, such as commands for designating a character code and a type of character font, commands for the full-color image data and data themselves, commands for CG inclusive of color designation, and commands for the spot colors.

20 Figs. 14A and 14B show one example of those commands. In Fig. 14A, denoted by 60 is one example of commands for the image data. Here, "image command" at the head one byte indicates the type of each command, next "CMM (color matching method)" is a byte for
25 designating a color processing or matching method (hereinafter referred to as CMM) used to process this

command string, and "coordinate" is plural bytes for designating positions in a page where the image is to be drawn. After that, other necessary byte strings follow and, at the last, the image data are transferred.

Similarly, 61, 62 denote examples of CG commands and character color designating commands, respectively. In these commands, a byte of "color designation" may be described in RGB representation or given by the registered number designating any spot color. As with the above example 60, the CMM type can be designated for each of the command strings. Accordingly, the optimum CMM can be designated depending on each command string.

As explained before with reference to Figs. 8A to 8D, by way of example, the color space compressing method (hereinafter referred to as CMM1) represented in Fig. 8B is suitable for image data, the method (hereinafter referred to as CMM2) represented in Fig. 8C is suitable for spot colors, and the method (hereinafter referred to as CMM3) represented in Fig. 8D is suitable for CG.

Subsequently, the analyzer 112 analyzes the input data and forms data in an intermediate format on a page-by-page basis. Fig. 15 shows one example of the intermediate format data. The intermediate format data

become a base from which the developing unit 113 forms the output data in a bit map format, and are arrayed into a record for each of the above command strings.

In Fig. 15, 170 to 173 denote examples of records

5 showing the text for characters, the text for spot colors, the image data, and the CG data, respectively.

Depending on the record type, entries making up each record comprises information which usually includes, as seen from Fig. 15, XY-coordinates in a
10 page, object type, CMM type, designated color, data size, character code, character type, address pointer for a data storage area, etc.

Then, it is determined in step S22 whether the input data for one page has completely been analyzed or
15 not by the analyzer 112. This determination is usually made based on whether a page updating command "FF" has been received or not. If the input data for one page has not yet been analyzed, then the process returns to step S20 for continuously receiving and analyzing the
20 data to form the intermediate format data.

If it is determined in step S22 that the input data for one page has completely been analyzed, then the process goes to step S23 for development and color processing. This step is executed by the developing
25 unit 113 and the color processor 114 based on the intermediate format data. More specifically, the

developing unit 113 develops the records shown in Fig. 15 one by one over a bit map memory. For the image data record 172, by way of example, the image data are read in accordance with the image storage address pointer and applied onto a bit map to spread over a size of (500 x 800) with XY-coordinates (40, 30) on the bit map locating at an upper left corner of the image. For each of all other records, the contained data are similarly developed over a bit map memory.

10 In step S23, the color processor 114 executes the color processing for each object based on the CMM type and the color information contained in the corresponding record. A process flow to be followed by the color processor 14 at this time is shown in Fig.

15 11.

Referring to Fig. 11, color information in the record to be processed is first read in step S30. The color information in this case is given by RGB representation or the registered number designating any spot color. Then, CMM type information in the record is read in step S31. After that, the selector 115 selects one current CMM in accordance with the CMM type information.

25 More specifically, it is first determined in step S32 whether the CMM type information indicates CMM1 or not. If so, then the current CMM is set to CMM1 in

step S36. Likewise, determination as to CMM2 and setting to CMM2 are performed in steps S33 and S35, respectively. If the determinations in steps S32 and S33 are both NO, then the current CMM is set to CMM3 in
5 step S34. CMM1 to CMM3 are stored in the color processing method storage 116 and selectively set as the current CMM on request.

In next step S37, the color processing is executed by using the current CMM. In the color processing, the
10 input data, i.e., input values in RGB representation or the registered numbers designating spot colors, are converted by the color processor 114 into data in CMYK representation which constitute color signals to be output from the printer. The color processing also
15 includes a process of color space compression executed to prevent color crush in high saturation zones caused by the difference in color reproduction range between the monitor and the printer which difference is produced during the conversion, as explained before.

20 Depending on the selected CMM, the color processing in the color processor 114 can be practiced by, for example, a table look-up method of preparing a table for color conversion beforehand and referring to the table in accordance with an input value to obtain
25 an output value, or a method of conducting arithmetic operation using a conversion formula, such as matrix

operation, on input values to calculate output values.

The developing unit 113 forms data to be stored four bit map memories for CMYK based on the output values resulted from the color processor 114 in accordance with the designated CMM. In other words, the color processor 114 serves as the so-called black box in the developing unit 113 so that it produces optimum output values depending on the input values and the designated CMM.

10 The process of step S23 is ended at the completion of forming of the four bit map data for CMYK. The prepared data are then output in step S24 as follows. The bit map data prepared in step S23 are converted by the output unit 117 into the form adapted for printing by a BJ head. The term "form" used herein depends on a configuration of the BJ head. In the case of the BJ head comprising vertical 64 nozzles, for example, the four bit map data for CMYK are each divided into blocks in units of 64 rasters from above.

20 Following the data conversion, the output unit 117 feeds a sheet of print paper, transmits one of the data blocks for CMYK to the BJ head, and further drives the BJ head for printing an image on the sheet of print paper. Then, the output unit 117 advances the sheet through a distance corresponding to the head height (64 dots in this case). After repeating such a series of

operations (i.e., for transmitting the data block, driving the BJ head, and advancing the sheet) for one page, the output unit 117 discharges the printed sheet, thereby ending the printing of one page.

5 With this embodiment, as described above, since desired one of color space compressing methods can selectively be used in the output apparatus depending on input data of an image, optimum color reproduction is enabled without increasing load imposed on the host
10 computer.

[Third Embodiment]

A third embodiment on the basis of the above second embodiment will be described below. While the CMM type is designated by one of commands from the host
15 computer in the above second embodiment, this third embodiment is arranged so as to automatically select optimum CMM in the output apparatus based on the object designation contained in the commands. This enables the designation of CMM type to be omitted from the
20 command string, as shown in Fig. 14B.

This third embodiment is of the same construction as the above second embodiment, but different in control therefrom. A description will now be given on those parts which are different from the above second
25 embodiment.

Fig. 12 shows a flow of color processing in the

third embodiment. Referring to Fig. 12, color information in the record to be processed is first read in step S40 similarly to the second embodiment. As mentioned above, the color information in this case is
5 given by RGB representation or the registered number designating any spot color or pallet color.

Then, object type information in the record is read in step S41. The record used in this embodiment includes no entry of CMM type information. In
10 accordance with the object type information, the selector 15 selects a current CMM. More specifically, it is first determined in step S42 whether the object type information indicates image data or not. If so, then the current CMM is set in step S46 to CMM1 which
15 is a color space compressing method most suitable for image data. It is then determined in step S43 whether the color information designates a spot color or not and, if so, the current CMM is set to CMM2 in step S45. If the determinations in steps S42 and S43 are both NO,
20 then the current CMM is set to CMM3 in step S44.

In next step S47, the color processing is executed by using the current CMM as with the second embodiment. The remaining parts of the process are the same as those in the second embodiment.

25 With the third embodiment, as described above, since optimum CMM is automatically select in the output

apparatus based on the object designation contained in
commands from the host computer, it is possible to omit
the designation of CMM type from a command string, in
addition to the above-mentioned advantage of the second
5 embodiment.

These second and third embodiments may also be
applied to a system comprising a plurality of units or
an apparatus comprising one unit.

It is needless to say that these second and third
10 embodiments are also applicable to the case where the
intended processing is achieved by loading a program
into the system or apparatus.

According to these second and third embodiments,
as described above, since desired one of color space
15 compressing methods can selectively be used in an
output apparatus depending on input data of an image,
optimum color reproduction is enabled without
increasing a burden imposed on a host computer, thereby
producing an ideal output.

20 Consequently, the present invention illustrated in
the foregoing embodiments provides color processing
means which is very advantageously built in a printer
receiving color visual data from a host computer or a
printer driver for a host computer.

25 Color matching methods applicable to the present
invention are not limited to the examples shown in Fig.

8, but may be replaced by any other suitable methods.

Furthermore, the color image output apparatus of the present invention may be a printer or a monitor. It is essential that input data are reproduced as a
5 color visible image.

As many apparently widely different embodiments of the present invention can be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the
10 specific embodiments thereof except as defined in the appended claims.



WHAT IS CLAIMED IS:

1. A color image processing method comprising the steps of:
 - receiving color visual data;
 - 5 determining attributes of said color visual data received; and
 - selecting a color matching method corresponding to said color visual data in accordance with a result of the determination.
- 10 2. A color image processing method according to claim 1, wherein said attributes indicate whether said color visual data represent a CG image or a natural image.
3. A color image processing method according to claim 1, wherein said color matching method includes a
- 15 preferred matching method.
4. A color image processing method according to claim 1, wherein said color matching method includes a least squares error method.
5. A color image processing apparatus comprising:
 - 20 input means for receiving color visual data expressed by page description language;
 - determining means for analyzing the page description language received by said input means and determining attributes of said color visual data
 - 25 expressed by the page description language; and





select means for selecting a color matching method corresponding to said color visual data expressed by the page description language in accordance with said attributes.

- 5 6. A color image processing apparatus according to claim 5, further comprising:

processing means for executing a color matching process in accordance with the color matching method selected by said select means.

- 10 7. A color image processing apparatus according to claim 5, further comprising:

conversion means for developing the page description language received by said input means and converting it into color visual data.

- 15 8. A color image output apparatus comprising:

input means for receiving visual data from an external apparatus;

analyzing means for analyzing the input data received by said input means;

- 20 data developing means for developing said input data into output data in accordance with a result analyzed by said analyzing means, and including color processing means which executes color processing on said input data;

- 25 storage means for storing a plurality of color processing methods to be executed by said color





processing means in said data developing means;

select means for selecting one of the plural color processing methods stored in said storage means, and

output means for outputting the data having been
5 developed by said developing means to be adapted for output,

wherein said select means selects one of the plural color processing methods stored in said storage means in accordance with the result analyzed by said
10 analyzing means on the input data received from said external apparatus, and wherein said developing means executes the color processing by said color processing means executes color in accordance with said selected color processing method.

15 9. A color image output apparatus according to claim 8, wherein said color processing method is a color matching method.

10. A color image output apparatus according to claim 8, wherein the visual data received by said input means
20 is expressed by page description language.

11. A color image output apparatus according to claim 8, wherein said output means is a printer.

12. A color image output apparatus according to claim 9, wherein said color matching method is a preferred
25 matching process.

13. A color image processing apparatus comprising:





input means for receiving color visual data;
determining means for determining attributes of
said color visual data received; and

select means for selecting a color matching method
5 corresponding to said color visual data in accordance
with a result of the determination.

14. A color image processing apparatus according to
claim 13, wherein said attributes indicate whether said
color visual data represent a CG image or a natural
10 image.

15. A color image processing apparatus according to
claim 13, wherein said color matching method includes a
preferred matching method.

16. A color image processing apparatus according to
15 claim 13, wherein said color matching method includes a
least squares error method.

17. A color image processing method comprising the
steps of:

receiving color visual data expressed by page
20 description language;

analyzing the page description language received
by said input means and determining attributes of said
color visual data expressed by the page description
language; and

25 selecting a color matching method corresponding to
said color visual data expressed by the page





description language in accordance with said attributes.

18. A color image processing method according to claim 17, further comprising the step of:

5 executing a color matching process in accordance with the color matching method selected by said select means.

19. A color image processing apparatus according to claim 17, further comprising the step of:

10 developing the page description language received by said input means and converting it into color visual data.

