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STORAGE MEDIUM STORING APPLICATION PROGRAM, METHOD, AND INFORMATION PROCESSING APPARATUS

Abstract

A storage medium storing an application program causing a computer of an information processing apparatus to execute a control method including accepting setting related to calibration, instructing a printing apparatus connected to the information processing apparatus to execute the calibration in accordance with the setting, obtaining capability information of the printing apparatus, determining whether the printing apparatus includes a module using a calibration result based on the capability information, generating print data based on intermediate data generated by general-purpose print software without correction when the printing apparatus includes a module using the calibration result, generating print data based on corrected intermediate data that is obtained by correcting the intermediate data using the calibration result obtained from the printing apparatus when the printing apparatus does not include a module using the calibration result, and sending the print data generated to the printing apparatus.

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Background/Summary

BACKGROUND

Field of the Disclosure

[0001] The present disclosure relates to a storage medium storing an application program, a method, and an information processing apparatus.

Description of the Related Art

[0002] There is a known configuration to issue a print instruction to a printing apparatus connected to the host computer while using a printer driver installed in the host computer as control software for the printing apparatus. An OS (Operating System), which is basic software, is installed in the host computer, and the printer driver is configured in accordance with a specification defined by the OS and is called from the OS to operate. On the other hand, a vendor that provides a printing apparatus can provide a means for instructing the printing apparatus to print using the OS by providing a printer driver that conforms to the specification of the OS. In the present specification, a vendor includes a manufacturer of a printing apparatus.

[0003] In recent years, Windows (registered trademark) has provided a standard class driver (hereinafter, also referred to as a “standard driver”) that can be used in common among printing apparatuses provided by vendors. The standard driver is packaged in the OS package, and an arbitrary printing apparatus can be easily usable by connecting to a host computer. Therefore, the standard driver is highly convenient because it is not necessary to separately install a model-specific printer driver suitable for a printing apparatus. The standard driver is configured to be able to designate a print function in accordance with a Print Device Capabilities (hereinafter, also referred to as a “PDC”) generated based on information obtained from the connected printing apparatus. This enables a user using the standard driver can designate a print function corresponding to capability of a connected printing apparatus even though the user uses one standard driver.

[0004] However, since functions that can be designated by a user are limited to functions that can be achieved only by the standard driver, the user cannot designate a vendor-specific function. In view of this, Japanese Patent Laid-Open Publication No. 2019-074906 (Counterpart of U.S. patent Ser. No. 10/747,481 B2) discloses a technique of expanding functions so as to achieve a page layout function, which is one of vendor-specific functions, by an expansion application associated with the standard driver.

[0005] In addition, conventionally, it is considered to execute a calibration function, which is one of vendor-specific functions, by an expansion application associated with the standard driver. The calibration function is a function of generating a correction coefficient for correcting unique characteristics of a printing apparatus or actually performing correction. For example, when a user prints using a calibration function relating to a gamma characteristic of a printing apparatus, a printed matter having the same gradation as that under an original environmental condition can be obtained even when the environmental condition changes.

[0006] However, if the image correction using the calibration result obtained from the printing apparatus is always executed by the expansion application in the host computer, there is a concern that the performance of the host computer may be degraded. In general, a printing apparatus performs image correction by an electronic circuit such as an ASIC designed to be able to execute an image process at high speed. Therefore, the performance is more likely to be degraded in the case where the host computer executes the image process as compared with the case where the printing apparatus executes the image process.

[0007] On the other hand, even if the printing apparatus is caused to perform image correction using the calibration result in consideration of performance degradation, a module for performing the corresponding image correction may not be installed in the printing apparatus due to an issue such as product cost. In such a case, the printing apparatus cannot provide the calibration function in printing using the standard driver. In addition, when a correction module is newly installed in the printing apparatus in order to provide the calibration function, the cost of the printing apparatus increases.

SUMMARY

[0008] Embodiments of the present disclosure provide a mechanism that improves the performance of correction based on a calibration result when a printing apparatus supported by general-purpose print software includes a module that uses the calibration result, and enable the correction even when the printing apparatus does not include the module.

[0009] Embodiments of the present disclosure provide a non-transitory computer-readable storage medium storing an application program causing a computer of an information processing apparatus, which executes general-purpose print software capable of generating print data printable by printing apparatuses provided by different vendors, to execute a control method including accepting setting related to calibration, instructing a printing apparatus connected to the information processing apparatus to execute the calibration in accordance with the setting related to the calibration, obtaining capability information of the printing apparatus, determining whether the printing apparatus includes a module that uses a result of the calibration based on the capability information of the printing apparatus, generating print data based on intermediate data generated by the general-purpose print software without correcting the intermediate data in a case where the printing apparatus includes a module that uses the result of the calibration, generating print data based on corrected intermediate data that is obtained by correcting the intermediate data using the result of the calibration obtained from the printing apparatus in a case where the printing apparatus does not include a module that uses the result of the calibration, and sending the print data generated to the printing apparatus.

[0010] Further features of the present disclosure will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. **1** is a block diagram illustrating a hardware configuration of a print system.

[0012] FIGS. **2**A and **2**B are diagrams illustrating software configurations of the print system.

[0013] FIG. **3** is a flowchart illustrating a calibration process performed by the printing apparatus.

[0014] FIG. **4** is a view illustrating an example of a density pattern.

[0015] FIG. **5** is a view illustrating an example of an effect of a calibration function.

[0016] FIG. **6**A is a view illustrating an example of a print setting screen.

[0017] FIGS. **6**B and **6**C are views illustrating examples of advanced setting screens in a first embodiment.

[0018] FIG. **7** is a flowchart illustrating a PDC editing process performed by a print function expansion unit of an expansion application.

[0019] FIGS. **8**A and **8**B are views illustrating examples of lists of capability information obtained from the printing apparatus in the first embodiment as tables.

[0020] FIG. **9** is a view illustrating an example of a list of print functions supported by the expansion application in the first embodiment as a table.

[0021] FIG. **10** is a view illustrating an example of a list of print functions supported by a general-purpose print software.

[0022] FIG. **11**A is a sequence chart illustrating operations of a drawing application, the general-purpose print software, the expansion application, and the printing apparatus in the first embodiment.
[0023] FIG. **11**B is a sequence chart illustrating operations of the drawing application, the general-purpose print software, the expansion application, and the printing apparatus in the first embodiment.
[0024] FIG. **11**C is a flowchart in which a flow from a step S**1119** to a step S**1123** in the sequence charts in FIGS. **11**A and **11**B is summarized while focusing the expansion application.
[0025] FIG. **12** is a view illustrating a software configuration of the print system when the expansion application is associated with the general-purpose print software and the printing apparatus in a second embodiment.
[0026] FIGS. **13**A and **13**B are views illustrating examples of lists of capability information obtained from the printing apparatus in the second embodiment as tables.
[0027] FIG. **14** is a view showing an example of a list of print functions supported by the expansion application in the second embodiment as a table.
[0028] FIGS. **15**A and **15**B are views respectively illustrating examples of a print setting screen and an advanced setting screen in the second embodiment.
[0029] FIG. **16** is a sequence chart illustrating operations of the drawing application, general-purpose print software, expansion application, and printing apparatus in the second embodiment.
[0030] FIG. **17** is a view illustrating a software configuration of the print system when the expansion application is associated with the general-purpose print software and the printing apparatus in a third embodiment.
[0031] FIGS. **18**A and **18**B are views illustrating examples of lists of capability information obtained from the printing apparatus in the third embodiment as tables.
[0032] FIG. **19** is a view illustrating an example of a list of print functions supported by the expansion application in the third embodiment as a table.
[0033] FIGS. **20**A and **20**B are views respectively illustrating examples of a print setting screen and an advanced setting screen in the third embodiment.
[0034] FIG. **21**A is a sequence chart illustrating operations of the drawing application, general-purpose print software, expansion application, and printing apparatus in the third embodiment.
[0035] FIG. **21**B is a sequence chart illustrating operations of the drawing application, general-purpose print software, expansion application, and printing apparatus in the third embodiment.
[0036] FIG. **22** is a view illustrating an example of a warning screen displayed on the display device.

DESCRIPTION OF THE EMBODIMENTS

[0037] Hereafter, embodiments according to the present disclosure will be described in detail by referring to the drawings. However, configurations described in the following embodiments are merely examples, and the scope of the present disclosure is not limited by the configurations described in the embodiments. For example, not all combinations of features described in the embodiments are necessarily essential to the solving means of the present disclosure. For example, each unit constituting the present disclosure can be replaced with any configuration capable of exhibiting the same function. In addition, an arbitrary constituent may be added. Any two or more configurations (features) of the embodiments can be combined. In second and third embodiments, the same configurations and processes as those of a first embodiment are denoted by the same reference numerals, and the description thereof will be omitted.
[0038] The first embodiment will now be described with reference to FIGS. **1** to **11**C.
[0039] FIG. **1** is a block diagram illustrating a hardware configuration of a print system. As illustrated in FIG. **1**, the print system includes a host computer **101** and a printing apparatus **102**. The host computer **101** (an information processing apparatus) may be a desktop personal computer, a smartphone, a notebook personal computer, or a tablet terminal. In FIG. **1**, the host computer **101**

has an input interface **110**, a CPU **111**, a ROM**112**, a RAM**113**, an external storage device **114**, an out interface **115**, an in/out interface **116**, and a network interface **117**. The input interface **110** is connected to input devices, such as a keyboard **118** and a pointing device **119**, and the output interface **115** is connected to a display device **120**.

[0040] For example, a print setting screen, an advanced setting screen, etc., which will be described later, are displayed on the display device **120**. The network interface **117** controls data transfer with an external apparatus via a network. The ROM **112** stores an initialization program etc. The external storage device **114** stores an application program group, an operating system (OS), print data generation software, and other various data. The RAM **113** is used as a work memory when executing various programs stored in the external storage device **114**. In this way, various programs can operate in the host computer **101**. In the first embodiment, the CPU **111** performs processes in accordance with procedures of programs stored in the ROM **112**, whereby the host computer **101** executes functions described later and processes illustrated in flowcharts and sequence charts described later.

[0041] The printing apparatus **102** is connected to the host computer **101** via the input/output interface **116**. The printing apparatus **102** includes an input/output interface **130**, a CPU **131**, a ROM **132**, a RAM **133**, a print unit **134**, and an ASIC **135**. The input/output interface **116** of the host computer **101** is connected to the input/output interface **130**. The CPU **131** controls the entire printing apparatus **102**. The ROM **132** stores a control program of the printing apparatus **102** and the like. The RAM **133** provides a memory area for temporarily storing various information when the CPU **131** executes the program. The print unit **134** forms an image on a sheet by an electrophotographic method. However, the print unit **134** is not limited to this, and may be an apparatus using another process such as an inkjet method. The ASIC **135** executes an image process, a process relating to calibration described later, etc. The printing apparatus **102** may be a multifunction peripheral having a plurality of functions, such as copy, print, and facsimile. Although the host computer **101** and the printing apparatus **102** are separately configured in this embodiment, they may be configured as one apparatus.

[0042] FIGS. **2**A and **2**B are diagrams illustrating software configurations of the print system. The following description is based on the print system using the host computer **101** on which Windows (registered trademark) 11 of Microsoft (registered trademark) is installed as the OS. FIG. **2**A shows a drawing application **201**, general-purpose print software **202**, and print function information **203** as a general software configuration of the print system. FIG. **2**B shows an expansion application **204** in addition to the general software configuration of the print system illustrated in FIG. **2**A. That is, FIG. **2**A is the diagram showing the general configuration in which the expansion application **204** is not associated with the general-purpose print software **202** and the printing apparatus **102**. FIG. **2**B shows the configuration in which the expansion application **204** is associated with the general-purpose print software **202** and the printing apparatus **102**. The drawing application **201**, the general-purpose print software **202**, the print function information **203**, and the expansion application **204** are stored in the external storage device **114** of the host computer **101**.

[0043] First, the software configuration of the print system in which the expansion application **204** is not associated with the general-purpose print software **202** and the printing apparatus **102** will be described with reference to FIG. **2**A. The drawing application **201** is software for generating contents (drawing data) to be printed. The drawing application **201** corresponds to, for example, a document creation application, a spreadsheet application, or the like. Upon receiving a print request from a user, the drawing application **201** issues a print instruction to the OS. The print instruction includes print setting information for instructing operations of the general-purpose print software **202** and the printing apparatus **102**. The print setting information is also referred to as a Print Ticket (hereinafter, referred to as a “PT”).

[0044] The drawing application **201** can display a print setting screen provided by any of the general-purpose print software **202**, the OS, and the drawing application **201** in order to output a

PT. When an advanced setting button in the print setting screen is selected, the general-purpose print software **202** additionally displays an advanced setting screen. Details of the print setting screen and the advanced setting screen will be described later with reference to FIGS. **6**A, **6**B, and **6**C. The advanced settings screen includes setting items (hereinafter also referred to as "controls") indicating print functions that can be set by a user in accordance with capability information of the general-purpose print software **202** and controls indicating set values thereof. The capability information is also called Print Capabilities (hereinafter, referred to as "PC").

[0045] The general-purpose print software **202** is a software program capable of generating print data printable by a plurality of printing apparatuses provided by different vendors. The general-purpose print software **202** determines a PC based on the print function information **203**. The print function information **203** is data indicating all print functions that can be set by a user, the set values thereof, and print functions in which the exclusive relationship between the set values is described. The print function information **203** is also called PDC (Print Device Capabilities). Hereinafter, the print capability information **203** is referred to as "PDC **203**". The PDC **203** is included in a configuration file of the general-purpose print software **202** that is stored in the external storage device **114** of the host computer **101** as an unchangeable file. Alternatively, the PDC **203** can be dynamically generated by the general-purpose print software **202** or the like. Specifically, the general-purpose print software **202** or the OS can be configured to obtain attribute data of the printing apparatus **102** from the printing apparatus **102** and generate the PDC **203** in accordance with the attribute information in the obtained attribute data. When the PDC **203** is dynamically generated, the generated PDC **203** can be edited.

[0046] The attribute data of the printing apparatus **102** is a response obtained by issuing a Get-Printer-Attributes operation of IPP (Internet Print Protocol) to the printing apparatus **102**. The response includes the attribute information indicating functions that can be designated in the printing apparatus **102** and set values associated with the attribute information. This response is stored in the RAM **113**. With this configuration, the general-purpose print software **202** can be configured so that the user can designate print functions available in the respective printing apparatuses connected to the host computer **101**. That is, even when printing apparatuses having different functions or printing apparatuses developed by different vendors are connected, the general-purpose print software **202** can be configured such that the user can designate a print function usable in each of the connected printing apparatuses. The vendor may be a manufacturer of a printing apparatus as described above.

[0047] Here, a configuration using an IPP Class Driver installed in Windows (registered trademark) **11** as the general-purpose print software **202** will be described. The IPP class driver is a printer driver that executes a print process in accordance with the specification of a standard print protocol called IPP, and is included in the package of the OS. The IPP class driver is not a unique printer driver corresponding to the model of the printing apparatus **102**, but is a standard class driver that can be used in common among a plurality of printing apparatuses.

[0048] The IPP class driver obtains the capability information of the connected printing apparatus **102** and generates the PDC **203** based on the information so that the user can designate a print function supported by the connected printing apparatus **102**. However, the IPP class driver does not support the calibration function and the correction function using the calibration result. This is because the two functions are functions unique to the vendor. Therefore, four points including the calibration function, a use case of the calibration function, a flow of the calibration process, and an effect of the calibration function will be described below.

[0049] First, the calibration function will be described. The calibration function is a function of generating a correction coefficient for correcting unique characteristics of the printing apparatus **102** or actually performing correction. In the following description, the calibration function for correcting the gamma characteristic will be described, but the present disclosure is not limited thereto. In the present disclosure, the calibration function may be a function of correcting the

unique characteristics of the printing apparatus **102**, such as color shift, color tone, inclination of laser, or head shift of an ink jet printer. In the calibration for correcting the gamma characteristic, the printing apparatus **102** outputs a density pattern, reads the density from the output pattern, and generates a gamma coefficient for correcting a deviation from a reference value. Thereafter, when printing image data, the printing apparatus **102** corrects image data using the gamma coefficient generated by calibration and prints the corrected image data, thereby always printing image data with the same gradation.

[0050] Analog characteristics of the printing apparatus **102** change due to various factors. And even when the same image data is printed, the gradation may vary depending on an output timing. For example, factors that change the analog characteristics include wear of the print unit **134** constituting the printing apparatus **102** and a change in environmental conditions. In such a case, the user can always obtain the printed matter having the same gradation even when the printing unit is consumed or the environmental condition is changed by printing using the calibration function.

[0051] Next, the flow of the calibration process performed by the printing apparatus **102** will be described using a flowchart illustrated in FIG. **3**. Note that each step of the flowchart illustrated in FIG. **3** is implemented by the ASIC **135** in the printing apparatus **102**, but may be implemented by the CPU **131** reading a program stored in the ROM **132** to the RAM **133** and executing it. First, in a step S**301**, the ASIC **135** outputs a density pattern. Thus, in the printing apparatus **102**, the density pattern is printed on an intermediate transfer belt or a sheet (not illustrated).

[0052] Here, the density pattern will be described with reference to FIG. **4**. FIG. **4** is a view showing an example of the density pattern. In the density pattern **401**, paper white regions **402** and gradation data from patches **403** to solid patches **404** are continuously arranged from the left to the right. The density pattern **401** is formed of the respective colors of C, M, Y, and K from the top. In the case of correction of color shift or color tone, other patches may be output.

[0053] Referring back to the description of FIG. **3**. Next, in a step S**302**, the ASIC **135** reads the density pattern **401** printed in the step S**301** with a sensor (not illustrated) to obtain signal values. Subsequently, in a step S**303**, the ASIC **135** compares the signal values of the read density pattern **401** with target values stored in advance, and generates a gamma coefficient (**1**D-LUT) that minimizes the differences between the signal values and the target values. Finally, in a step S**304**, the ASIC **135** stores the generated gamma coefficient (**1**D-LUT) in the ASIC **135**. Thereafter, the flowchart illustrated in FIG. **3** is terminated.

[0054] Next, the effect of the calibration function will be described with reference to FIG. **5**. In FIG. **5**, a horizontal axis represents an input signal value and a vertical axis represents an output signal value. A broken line **501** indicates the target values of the tone, a solid line **502** indicates the output signal values read from the patches in the step S**302**, and a solid line **503** indicates the gamma coefficient (**1**D-LUT) generated in the step S**303**. In FIG. **5**, the output result of the patches (solid line **502**) has an upwardly convex characteristic as compared with the target values (broken line **501**), and therefore, the gamma coefficient (solid line **503**) has a downwardly convex characteristic in order to match the output result of patches (solid line **502**) to the target values (broken line **501**).

[0055] The printing apparatus **102** performs the image correction using the gamma coefficient generated by the calibration function, and thus can always perform printing with a gradation as targeted even when there is wear of the printing unit or a change in environmental conditions. However, the calibration function is a vendor-specific function as described above, and therefore is not displayed on the advanced setting screen displayed by the general-purpose print software **202**. That is, when using the IPP class driver, the user cannot select the calibration function, and cannot perform printing using the calibration function.

[0056] Referring back to the description of FIG. **2**A. When a print instruction is issued from the drawing application **201**, a module of the OS in the general-purpose print software **202** generates intermediate data. The data output for printing by the drawing application **201** is data in the

Graphic Device Interface format (data in the GDI format) or data in the XML Paper Specification format (data in the XPS format). Here, an IPP class driver shall be used as the general-purpose print software **202**. In this case, when the data output from the drawing application **201** is data in the GDI format, the OS converts the data in the GDI format output from the drawing application **201** into data in the XPS format. The intermediate data includes drawing data that is information of an image to be formed on a sheet and a PT set by the user.

[0057] The general-purpose print software **202** converts the generated intermediate data into print data that can be interpreted by the printing apparatus **102**, and transmits the print data to the printing apparatus **102**. Here, the print data is a PDL (Page Description Language) data conforming to the IPP. The PDL data conforming to the IPP is, for example, data in a PDF (Portable Document Format) or a PWG-Raster format. The print data includes a drawing data that is information about an image formed on a sheet and print setting attribute information (attribute information designating print setting) generated based on the PT set by the user. The print setting attribute information includes attribute information indicating functions that can be designated by the printing apparatus **102** and set values associated with the attribute information.

[0058] The printing apparatus **102** performs printing on a sheet based on the print data sent from the general-purpose print software **202**. At this time, the printing apparatus **102** forms the drawing data included in the print data on a sheet by an operation according to the print setting attribute information included in the print data. The print setting attribute information includes the attribute information for designating print quality (image quality priority, speed priority, etc.), double-sided printing, etc., and set values thereof. For example, when the print setting attribute information includes attribute information designating the double-sided printing and a set value indicating that the double-sided printing is to be operated, the printing apparatus **102** executes the double-sided printing.

[0059] Next, the software configuration of the print system in which the expansion application **204** is associated with the general-purpose print software **202** and the printing apparatus **102** will be described with reference to FIG. **2**B. Note that the configuration and process not particularly mentioned below are the same as those in FIG. **2**A. The expansion application **204** is software for expanding the function of the general-purpose print software **202**, and is software that is not included in the OS in advance (not packaged together).

[0060] As such, the user needs to operate the host computer **101** and download the expansion application **204** from a server to the host computer **101** via the Internet and install it. Alternatively, the expansion application **204** may be automatically installed in the host computer **101** in response to the connection of the printing apparatus **102** to the host computer **101**. Specifically, when the printing apparatus **102** is connected to the host computer **101**, the OS obtains the device identification information from the printing apparatus **102**. Further, the OS downloads the expansion application **204** corresponding to the obtained device identification information from the server to the host computer **101** via the Internet and installs the expansion application. That is, the general-purpose print software **202** and the expansion application **204** are stored in the host computer **101** as different files. Alternatively, the expansion application **204** may be installed in the host computer **101** by the CPU **111** of the host computer **101** reading the expansion application **204** stored in the storage medium.

[0061] The general-purpose print software **202** and the expansion application **204** may be updated and upgraded, but these update processes are also performed at different timings. That is, the timing at which the host computer **101** obtains the general-purpose print software **202** is different from the timing at which the host computer **101** obtains the expansion application **204**. Further, a trigger for the host computer **101** to obtain the general-purpose print software **202** is different from a trigger for the host computer **101** to obtain the expansion application **204**. When the expansion application **204** is installed, the OS associates the expansion application **204** with the general-purpose print software **202** and the printing apparatus **102**.

[0062] As illustrated in FIG. **2**B, the expansion application **204** has a print-setting-screen expansion unit **205**, a print function expansion unit **206**, an intermediate data editing unit **207**, a notification unit **208**, and a calibration instructing unit **209**. The expansion application **204** has shared information **210** that can be accessed in common by the units. An actual state of the shared information **210** is a file saved in the external storage device **114** or information stored in the RAM **113** in the host computer **101**. The expansion application **204** writes and reads information to and from the shared information **210** by using an API (Application Program Interface) provided by the OS. The expansion application **204** may end the operation every time the process of each unit is finished. In this case, the OS activates the expansion application **204** every time a request to use each unit is received. Further, the expansion application **204** may cancel the process in the process of each unit. When the process is cancelled, the OS deletes the job in processing on the print queue.
[0063] Upon receiving a print request from the user, the drawing application **201** issues a print instruction to the OS. Even in the configuration of FIG. **2**B, the drawing application **201** can display the print setting screen as with the configuration of FIG. **2**A. Further, in the configuration of FIG. **2**B, the advanced setting screen provided by the expansion application **204** is displayed. Specifically, the advanced setting screen provided by the print-setting-screen expansion unit **205** of the expansion application **204** is displayed. The print-setting-screen expansion unit **205** can store information about the advanced setting set by the user (hereinafter, referred to as "advanced setting information") in the shared information **210**. The print-setting-screen expansion unit **205** will be described in detail later.
[0064] The intermediate data editing unit **207** obtains intermediate data from the general-purpose print software **202**, converts the obtained intermediate data to print data, and then transfers the print data to the printing apparatus **102**. Hereinafter, the intermediate data editing unit **207** will be described in detail. When the printing apparatus **102** has the gamma correction function, the intermediate data editing unit **207** converts the intermediate data into the print data without performing the gamma correction. On the other hand, when the printing apparatus **102** does not have the gamma correction function, the intermediate data editing unit **207** obtains the gamma coefficient from the printing apparatus **102**, performs the gamma correction on the intermediate data, and converts the intermediate data into the print data. The printing apparatus **102** applies a necessary image process to the received print data and prints on a sheet.
[0065] The method of converting the intermediate data into the print data is not limited to the above method. The expansion application **204** may be configured to obtain print data generated by the general-purpose print software **202** and add the advanced setting to the print data. Even in the configuration of FIG. **2**B, the calibration setting may not be performed by a user. In this case, the general-purpose print software **202** may transfer the print data to the printing apparatus **102** without passing through the expansion application **204** as with the configuration of FIG. **2**A.
[0066] The print function expansion unit **206** may edit the PDC **203** generated by the general-purpose print software **202** or the OS. Thus, the print function expansion unit **206** can add a function provided by the expansion application **204** or a function (for example, a calibration function) supported by the printing apparatus **102** but not supported by the general-purpose print software **202**. Furthermore, the print function expansion unit **206** can add an exclusive relationship between the set values of the print functions. The OS activates the print function expansion unit **206** when the expansion application **204** is associated with the printing apparatus **102** and the general-purpose print software **202** at first. Further, the OS may activate the print function expansion unit **206** at other timings (for example, at the time of activation of the OS). In this way, in a case where an optional apparatus (for example, a finisher) is added to the printing apparatus **102** later and functions relating to printing are expanded, the print function expansion unit **206** can detect the expanded function and add it to the PDC **203**.
[0067] The notification unit **208** can display a notification to the user in response to an error occurring in the printing apparatus **102**. For example, when a paper empty error occurs in the

printing apparatus **102**, the general-purpose print software **202** detects the error, and the OS causes the display device **120** to display a message using a notification function called a toast notification, which is a function of the OS. When the user selects the toast notification by the pointing device **119**, the notification unit **208** is called by the OS, and a UI screen of the notification unit **208** is displayed. The notification unit **208** can display, for example, a detailed message about the paper empty error and a paper filling method on the UI screen.

[0068] The calibration instructing unit **209** obtains the detailed setting information from the shared information **210**, and if the calibration is set, transmits a calibration instruction to the printing apparatus **102**. The calibration instructing unit **209** obtains the capability information of the printing apparatus **102** from the shared information **210**, and determines whether the printing apparatus **102** has the gamma correction function. When the printing apparatus **102** has the gamma correction function, the calibration instructing unit **209** receives a calibration end notification from the printing apparatus **102** upon completion of the calibration operation of the printing apparatus **102**, and ends the process.

[0069] In contrast, when the printing apparatus **102** does not have the gamma correction function, the calibration instructing unit **209** obtains the gamma coefficient from the printing apparatus **102** and stores the obtained gamma coefficient in the shared information **210**. Specifically, when receiving the calibration instruction, for example, the printing apparatus **102** outputs the density patches as illustrated in FIG. **4**, reads the output density patches, and generates the gamma coefficient with which the output results (solid line **502**) of the patches becomes the target values (broken line **501**). When the printing apparatus **102** does not have the gamma correction function, the generated gamma coefficient is transmitted to the expansion application **204** by the printing apparatus **102** and stored in the shared information **210**.

[0070] Once the expansion application **204** transmits the print data to the printing apparatus **102**, the expansion application **204** cannot display a screen such as a guide associated with the print data during the process of each unit. The configuration of the expansion application **204** is not limited to the configuration having all the functions (units) described above, and may have only a part of the functions or may have other functions. The expansion application **204** may be simply referred to as printing software.

[0071] As described above, the expansion application **204** has at least one of the following functions. The first is the function of displaying the setting screen (the print-setting-screen expansion unit **205**). The second is the function of editing the intermediate data to convert the intermediate data into the print data and adding the advanced setting to the print data (the intermediate data editing unit **207**). The third is the function of expanding a function that can be designated by the print data generation software (the print function expansion unit **206**). The fourth is the function of displaying a screen in response to the occurrence of an error in the printing apparatus **102** (the notification unit **208**).

[0072] Next, examples of the print setting screen and the advanced setting screen will be described with reference to FIGS. **6**A, **6**B, and **6**C. FIG. **6**A is a view illustrating the print setting screen displayed by the drawing application **201**. FIG. **6**B is a view illustrating the advanced setting screen displayed in the case of the configuration illustrated in FIG. **2**A, that is, the configuration without the expansion application **204**. FIG. **6**C is a view illustrating the advanced setting screen displayed in the case of the configuration illustrated in FIG. **2**B, that is, the configuration having the expansion application **204**. The unit or module for displaying the print setting screen is not limited to the above. For example, the print-setting-screen expansion unit **205** may be configured to only generate the display screen. In this case, the print-setting-screen expansion unit **205** transmits the generated display screen to the drawing application **201** via the general-purpose print software **202**. The drawing application **201** displays the display screen obtained in this way.

[0073] First, the print setting screen illustrated in FIG. **6**A will be described. In a control **601**, a printer (that is, a printing apparatus) used for printing, a print orientation, and the number of copies

can be set by a user. A control **602** is a preview screen, a control **603** is a button for starting printing, and a control **604** is a button for canceling printing. A control **605** is an advanced setting button. When the control **605** is selected, the additional advanced setting screen is displayed by the general-purpose print software **202** or the print-setting-screen expansion unit **205**.

[0074] Next, the advanced setting screen illustrated in FIG. **6**B will be described. FIG. **6**B illustrates the additional advanced setting screen that is displayed by the general-purpose print software **202** in the absence of the expansion application **204**. In a control **606**, a sheet type can be set by a user, and in FIG. **6**B indicates that "Plain paper" is set. In a control **607**, a sheet size can be set by a user, and FIG. **6**B indicates that an "A**4**" size is set. In a control **608**, a sheet feeding port can be set by a user, and FIG. **6**B indicates that "Auto" is set. The control **609** is a button for ending the setting. When the control **609** is selected by the pointing device **119**, the display screen shifts from the advanced setting screen illustrated in FIG. **6**B to the print setting screen illustrated in FIG. **6**A.

[0075] Next, the advanced setting screen illustrated in FIG. **6**C will be described. FIG. **6**C illustrates the additional advanced setting screen that is displayed by the print-setting-screen expansion unit **205** in the presence of the expansion application **204**. The advanced setting screen in FIG. **6**C is constituted by adding a check box **610** to the advanced setting screen in FIG. **6**B. The check box **610** is button that allows a user to set the calibration, and in FIG. **6**C indicates that the calibration is set.

[0076] Here, the reason why the print setting items are different between the advanced setting screen in FIGS. **6**B and **6**C will be described. The advanced setting screen is generated by referring to the PC generated based on the print function information and setting screen display information indicating whether to display functions illustrated in FIGS. **8**A and **8**B, which will be described later, on the screen. However, since the general-purpose print software **202** does not support the calibration function, the calibration function cannot be added to the print function information. Even if the print function information originally includes the calibration function, the general-purpose print software **202** cannot interpret the calibration function included in the print function information. Therefore, the general-purpose print software **202** cannot display the check box **610** that allows the calibration setting on the advanced setting screen. On the other hand, when the expansion application **204** is provided, the print function expansion unit **206** adds the calibration functions to the PC and the print-setting-screen expansion unit **205** displays the advanced setting screen by referring to the PDC **203** and the setting screen display information. With these configurations, the expansion application **204** can display the check box **610** that allows the calibration setting on the advanced setting screen.

[0077] Here, a flow of an editing process of the PDC **203** executed by the print function expansion unit **206** of the expansion application **204** will be described using a flowchart illustrated in FIG. **7**. Each step of the flowchart illustrated in FIG. **7** is achieved by the CPU **111** activating the expansion application **204** in the host computer **101**. First, in a step S**701**, the CPU **111** obtains capability information from the printing apparatus **102** by the print function expansion unit **206**. The capability information includes attribute information indicating functions that can be designated in the printing apparatus **102** and set values associated with the attribute information, which are included in a response obtained by issuing an IPP Get-Printer-Attributes operation to the printing apparatus **102**. FIGS. **8**A and **8**B are views illustrating examples of lists of capability information obtained from the printing apparatus **102** as tables. A table **801** illustrated in FIG. **8**A is an example of a list of capability information in the case where the printing apparatus **102** has the gamma correction function. A table **802** illustrated in FIG. **8**B is an example of a list of capability information in a case where the printing apparatus **102** does not have the gamma correction function. The capability information of the printing apparatus **102** is stored in the shared information **210**.

[0078] Referring back to the description of FIG. **7**. Next, in a step S**702**, the CPU **111** obtains a list

of the print functions supported by the expansion application **204** from the shared information **210** by the print function expansion unit **206**. The list of the print functions supported by the expansion application **204** describes all print functions that can be processed by the expansion application **204** and their set values, and is stored in the shared information **210**. A table **901** illustrated in FIG. **9** is an example of a list of print functions supported by the expansion application **204**. The list of the print functions supported by the expansion application **204** may be updated according to update of the expansion application **204**. As illustrated in FIG. **9**, the list of the print functions supported by the expansion application **204** also includes the setting screen display information. The setting screen display information is referred to by the print-setting-screen expansion unit **205**, and is information indicating whether the respective functions are displayed on the advanced setting screen in FIG. **6**C. The reason why the gamma correction is not displayed on the advanced setting screen is that the gamma correction is a function of always correcting an image by the gamma coefficient generated by the calibration function, unlike the function of switching the setting as in the sheet size.

[0079] Referring back to the description of FIG. **7**. Subsequently, in a step S**703**, the CPU **111** obtains the PDC **203** generated by the general-purpose print software **202** from the OS by the print function expansion unit **206**. A table **1001** illustrated in FIG. **10** is an example of a list of print functions supported by the general-purpose print software **202**. The PDC **203** generated by the general-purpose print software **202** is generated based on the table **801** or the table **802** that is the capability information list obtained by the general-purpose print software **202** from the printing apparatus **102**. Since only the print functions supported by the general-purpose print software **202** are described in the PDC **203** generated by the general-purpose print software **202** among the capability information obtained from the printing apparatus **102**, the print functions of the PDC **203** are limited.

[0080] For example, the table **901**, which is the list of print functions supported by the expansion application **204**, includes options of “7×10 Inch” and “western type No. 6” as the sheet size. However, the general-purpose print software **202** does not support the options of the sheet sizes concerned, and the options of the sheet sizes are not described in the PDC **203**. Therefore, the print function expansion unit **206** adds a function or an option to the PDC **203**, and thus the expansion application **204** becomes able to supplement the lack of the function of the general-purpose print software **202**. The print function expansion unit **206** can also delete unnecessary function and option from the PDC **203** generated by the general-purpose print software **202**.

[0081] Referring back to the description of FIG. **7**. Subsequent steps S**704**, S**705**, and S**706** are processes repeatedly performed for the list of combinations of functions and options included in the capability information obtained from the printing apparatus **102** in the step S**701**. That is, the processes in the steps S**704**, S**705**, and S**706** are repeatedly performed for the list of combinations of functions and options in the tables **801** and **802**. First, in the step S**704**, the CPU **111** determines, by the print function expansion unit **206**, whether the combination of function and option under processing are included in the PDC **203** generated by the general-purpose print software **202**.

[0082] When the CPU **111** determines, by the print function expansion unit **206**, that the combination of function and option under processing is included in the PDC **203** generated by the general-purpose print software **202**, the process returns to the step S**704**. At this time, the CPU **111** selects, by the print function expansion unit **206**, the next items from the combinations of functions and options of the capability information obtained from the printing apparatus **102** and performs the process in the step S**704** again. However, when the CPU **111** determines, by the print function expansion unit **206**, that the last item among the combinations of functions and options included in the capability information obtained from the printing apparatus **102** is under processing, the CPU **111** ends the process of the flowchart illustrated in FIG. **7**. On the other hand, when the CPU **111** determines, by the print function expansion unit **206**, that the combination of function and option under processing is not included in the PDC **203** generated by the general-purpose print software

202, the process proceeds to the step S**705**.
[0083] Specifically, for example, “Sheet size: A**4**” illustrated in the table **801**, which is the capability information list of the printing apparatus **102**, is also included in the table **1001**, which is the capability information list of the general-purpose print software **202**. In this case, the CPU **111** determines, by the print function expansion unit **206**, that the combination of function and option under processing is included in the PDC **203** generated by the general-purpose print software **202**. In contrast, “Calibration: Apply” illustrated in the table **801**, which is the capability information list of the printing apparatus **102**, is not included in the table **1001**, which is the capability information list of the general-purpose print software **202**. In this case, the CPU **111** determines, by the print function expansion unit **206**, that the combination of function and option under processing is not included in the PDC **203** generated by the general-purpose print software **202**. As a result, the process proceeds to the step S**705**.
[0084] Next, in the step S**705**, the CPU **111** determines, by the print function expansion unit **206**, whether the combination of function and option under processing is included in the combinations of functions and options supported by the expansion application **204**. When the CPU **111** determines, by the print function expansion unit **206**, that the combination of function and option under processing is included in the combinations of functions and options supported by the expansion application **204**, the process proceeds to the step S**706**.
[0085] In contrast, when the CPU **111** determines, by the print function expansion unit **206**, that the combination of function and option under processing is not included in the combinations of functions and options supported by the expansion application **204**, the process returns to the step S**704**. At this time, the CPU **111** selects, by the print function expansion unit **206**, the next item from among the combinations of functions and options of the capability information obtained from the printing apparatus **102** and performs the process in the step S**704** again. However, when the CPU **111** determines, by the print function expansion unit **206**, that the last item among the combinations of functions and options included in the capability information obtained from the printing apparatus **102** is under processing, the CPU **111** ends the process of the flowchart illustrated in FIG. **7**.
[0086] Specifically, for example, when the combination of function and option under processed is “Calibration: Apply”, the combination is also included in the table **901** that is the capability information list of the expansion application **204**. In this case, the CPU **111** determines, by the print function expansion unit **206**, that the combination of function and option under processing is included in the combinations of functions and options supported by the expansion application **204**. As a result, the process proceeds to the step S**706**.
[0087] Subsequently, in the step S**706**, the CPU **111** adds, by print function expansion unit **206**, the combination of function and option under processing to the PDC **203**. Thereafter, the process returns to the step S**704**. At this time, the CPU **111** selects, by the print function expansion unit **206**, the next item from among the combinations of functions and options of the capability information obtained from the printing apparatus **102** and performs the process in the step S**704** again. However, when the CPU **111** determines, by the print function expansion unit **206**, that the last item among the combinations of functions and options included in the capability information obtained from the printing apparatus **102** is under processing, the CPU **111** ends the process of the flowchart illustrated in FIG. **7**.
[0088] As described above, the CPU **111** adds, by the print function expansion unit **206**, the combination of function and option that is not supported by the general-purpose print software **202**, is supported by the printing apparatus **102**, and is supported by the expansion application **204** to the PDC **203**. Specifically, when the capability information list of the printing apparatus **102** is the table **801**, three items of “Calibration: Apply”, “Calibration: Not Apply”, and “Gamma correction” are added to the PDC **203**. In contrast, when the capability information list of the printing apparatus **102** is the table **802**, two items of “Calibration: Apply” and “Calibration: Not apply” are added to

the PDC **203**, but "Gamma correction" is not added.
[0089] The PC is generated on the basis of the PDC **203** edited by such an editing process flow. Further, the print-setting-screen expansion unit **205** generates a display screen based on the generated PC and the setting screen display information. This adds the function that is not supported by the general-purpose print software **202** and selects the option to be displayed. As a result, the advanced setting screen in FIG. **6**C can be displayed.
[0090] Next, sequences of operations of the drawing application **201**, the general-purpose print software **202**, the expansion application **204**, and the printing apparatus **102** after the drawing application **201** accepts the print setting will be described with reference to FIGS. **11**A and **11**B. FIG. **11**A illustrates the sequence (method) in a case where the capability information list of the printing apparatus **102** is the table **801**. FIG. **11**B illustrates the sequence (method) in a case where the capability information list of the printing apparatus **102** is the table **802**. Steps other than the steps executed by the printing apparatus **102** in FIGS. **11**A and **11**B are achieved by the CPU **111** (a computer) activating the drawing application **201**, the general-purpose print software **202**, and the expansion application **204** (programs) in the host computer **101**. On the other hand, the steps executed by the printing apparatus **102** in FIGS. **11**A and **11**B are achieved by the ASIC **135** in the printing apparatus **102**, but may be achieved the CPU **131** reading the program stored in the ROM **132** to the RAM **133** and executing the program. The sequences in FIGS. **11**A and **11**B assume that the software configuration of the print system has the configuration in FIG. **2**B.
[0091] The sequence in FIG. **11**A, that is, the sequence in the case where the capability information list of the printing apparatus **102** is the table **801** will be described. First, in a step S**1101**, the CPU **111** of the host computer **101** accepts the print setting from a user by the drawing application **201**. The user can instruct the drawing application **201** to execute the print setting by operating the keyboard **118** or the pointing device **119**. Next, in a step S**1102**, the CPU **111** displays the print setting screen illustrated in FIG. **6**A on the display device **120** by the drawing application **201**. Subsequently, in a step S**1103**, the CPU **111** accepts an advanced setting instruction by the drawing application **201**. The user can instruct the advanced setting by selecting the control **605** while operating the pointing device **119**.
[0092] Next, in a step S**1104**, the CPU **111** requests, by the drawing application **201**, the general-purpose print software **202** to display the advanced setting. Subsequently, in a step S**1105**, the CPU **111** requests, by the general-purpose print software **202**, the expansion application **204** to display the advanced setting. Unlike the assumption, if the software configuration of the print system has the configuration in FIG. **2**A, the general-purpose print software **202** displays the advanced setting screen in FIG. **6**B on the display device **120** as described above. Next, in a step S**1106**, the CPU **111** displays the advanced setting screen in FIG. **6**C on the display device **120** by the print-setting-screen expansion unit **205** of the expansion application **204**. As described in the description about FIG. **6**C, the calibration function is added to the PDC **203** by the print function expansion unit **206**. Therefore, in the step S**1106**, the print-setting-screen expansion unit **205** displays the advanced setting screen in FIG. **6**C on the display device **120** by referring to the PC generated based on the PDC **203** after the addition and the setting screen display information in FIG. **9**.
[0093] Subsequently, in a step S**1107**, the CPU **111** (a reception unit) receives the advanced setting by the print-setting-screen expansion unit **205** (a reception process). In the case of the advanced setting screen in FIG. **6**C, the print-setting-screen expansion unit **205** accepts that "Sheet type: Plain paper", "Sheet size: A**4**", "Sheet feeding port: Auto", and "Calibration: Apply" are set by the user. Next, in a step S**1108**, the CPU **111** accepts the end of the advanced setting by the print-setting-screen expansion unit **205**. The user can instruct the end of the advanced setting by selecting the control **609** while operating the pointing device **119**. When the advanced setting is completed, the print-setting-screen expansion unit **205** stores the advanced setting information in the shared information **210**. The print-setting-screen expansion unit **205** closes the advanced setting screen in FIG. **16**C on the display device **120**. As a result, the display device **120** displays the print

setting screen illustrated in FIG. **6**A again.

[0094] Subsequently, in a step S**1109**, the CPU **111** transmits, by the expansion application **204**, the end of the advanced setting to the general-purpose print software **202**. Next, in a step S**1110**, the CPU **111** transmits the end of the advanced setting to the drawing application **201** by the general-purpose print software **202**. Subsequently, in a step S**1111**, the CPU **111** accepts a print instruction by the drawing application **201**. The user can instruct printing by selecting the control **603** while operating the pointing device **119**. Next, in a step S**1112**, the CPU **111** instructs, by the drawing application **201**, the general-purpose print software **202** to print.

[0095] Subsequently, in a step S**1113**, the CPU **111** generates the intermediate data by the general-purpose print software **202**. At this time, the general-purpose print software **202** uses a module of the OS. Next, in a step S**1114**, the CPU **111** stores the PT included in the intermediate data in the shared information **210** by the general-purpose print software **202**. Subsequently, in a step S**1115**, the CPU **111** transfers the drawing data included in the intermediate data to the expansion application **204** by the general-purpose print software **202**. Next, in a step S**1116**, the CPU **111** obtains, by the calibration instruction unit **209** of the expansion application **204**, the PT stored in the step S**1114** and the advanced setting information stored in the step S**1108** from the shared information **210**.

[0096] Subsequently, in a step S**1117**, the CPU **111** (an instructing unit) instructs the printing apparatus **102** to perform the calibration by the calibration instruction unit **209** (an instruction step). Next, in a step S**1118**, the ASIC **135** of the printing apparatus **102** executes the calibration. The calibration is executed according to the calibration process of the flowchart in FIG. **3**. Subsequently, in a step S**1119**, the ASIC **135** of the printing apparatus **102** transmits a calibration end to the calibration instruction unit **209** of the expansion application **204**. As a result, the CPU **111** of the host computer **101** receives the calibration end by the calibration instruction unit **209** of the expansion application **204**.

[0097] Next, in a step S**1120**, the CPU **111** (a first obtaining unit) obtains the capability information of the printing apparatus **102** from the shared information **210** by the intermediate data editing unit **207** of the expansion application **204** (a first obtaining process). Subsequently, in a step S**1121**, the CPU **111** determines, by the intermediate data editing unit **207**, whether the printing apparatus **102** includes a module using the calibration result. In the first embodiment, the CPU **111** (a determination unit) determines, by the intermediate data editing unit **207**, whether the printing apparatus **102** has the gamma correction function from the capability information of the printing apparatus **102** (a determination step). In this regard, FIG. **11**A illustrates the sequence in the case where the capability information list of the printing apparatus **102** is the table **801** as described above. Therefore, in the step S**1121**, the CPU **111** determines, by the intermediate data editing unit **207**, that the printing apparatus **102** has the gamma correction function from the capability information of the printing apparatus **102**. Next, in a step S**1122**, the CPU **111** (a first generation unit) converts the intermediate data into the print data without performing the gamma correction by the intermediate data editing unit **207**. In this way, the print data is generated (a first generation step). Subsequently, in a step S**1123**, the CPU **111** (a first sending unit and a second sending unit) sends the print data to the printing apparatus **102** by the intermediate data editing unit **207** (a first sending step and a second sending step).

[0098] Next, in a step S**1124**, the ASIC **135** of the printing apparatus **102** interprets the print data and applies the necessary image process to the image of the print data. For example, when the advanced setting in FIG. **6**C is set, the ASIC **135** of the printing apparatus **102** performs the gamma correction with the gamma coefficient generated by the calibration in the step S**1118** and a screen process. Next, in a step S**1125**, the ASIC **135** of the printing apparatus **102** prints the image data generated in the image process in the step S**1124**. Since the gamma correction is performed in the step S**1124**, the tone of printed matter matches the target as compared with the case where the gamma correction is not performed. The sequence in the case where the capability information list

of the printing apparatus **102** is the table **801**, that is, the sequence in the case where the printing apparatus **102** has the gamma correction function has been described above.

[0099] Next, the sequence in FIG. **11**B, that is, the sequence in the case where the capability information list of the printing apparatus **102** is the table **802** will be described. The steps with the same numeral references in FIG. **11**B are the same processes in FIG. **11**A, and therefore, the description thereof will be omitted. In a step S**1126**, the CPU **111** of the host computer **101** determines whether the printing apparatus **102** includes a module that uses the calibration result by using the intermediate data editing unit **207** of the expansion application **204**. In the first embodiment, the CPU **111** (a determination unit) determines, by the intermediate data editing unit **207**, whether the printing apparatus **102** has the gamma correction function from the capability information of the printing apparatus **102** (a determination step). In this regard, FIG. **11**B illustrates the sequence in the case where the capability information list of the printing apparatus **102** is the table **802** as described above. Therefore, in a step S**1126**, the CPU **111** determines from the capability information of the printing apparatus **102** by the intermediate data editing unit **207** that the printing apparatus **102** does not have the gamma correction function.

[0100] Next, in a step S**1127**, the CPU **111** requests the calibration result (gamma coefficient) from the printing apparatus **102** by the intermediate data editing unit **207**. Subsequently, in a step S**1128**, the ASIC **135** of the printing apparatus **102** sends the calibration result (gamma coefficient) to the intermediate data editing unit **207** of the expansion application **204**. Accordingly, the CPU **111** (a second obtaining unit) of the host computer **101** obtains, by the intermediate data editing unit **207** of the expansion application **204**, the calibration result (gamma coefficient) (a second obtaining step). Next, in a step S**1129**, the CPU **111** (a correction unit) causes the intermediate data editing unit **207** to perform the gamma correction on the intermediate data (a correction process) using the calibration result (gamma coefficient). Subsequently, in a step S**1130**, the CPU **111** (a second generation unit) generates the print data based on the gamma-corrected intermediate data by the intermediate data editing unit **207** (a second generation process). The sequence in the case where the capability information list of the printing apparatus **102** is the table **802**, that is, the sequence in the case where the printing apparatus **102** does not have the gamma correction function has been described above.

[0101] FIG. **11**C is a flowchart in which the flow from the step S**1119** to the step S**1123** in the sequence charts in FIGS. **11**A and **11**B is summarized while focusing the expansion application **204**. The expansion application **204** performs the process in the step S**1119** by the calibration instruction unit **209** thereof. The expansion application **204** performs the process in the step S**1120** by the intermediate data editing unit **207** thereof. Further, the expansion application **204** performs the determination process in the step S**1121** or the step S**1126** by the intermediate data editing unit **207**.

[0102] At this time, when the expansion application **204** determines, by the intermediate data editing unit **207**, that the printing apparatus **102** has the gamma correction function from the capability information of the printing apparatus **102**, the processes in the step S**1122** and the step S**1123** are performed. On the other hand, when the expansion application **204** determines, by the intermediate data editing unit **207**, that the printing apparatus **102** does not have the gamma correction function from the capability information of the printing apparatus **102**, the processes from the step S**1127** to the step S**1130** are performed.

[0103] As described above, the CPU **111** of the host computer **101** issues the calibration instruction to the printing apparatus **102** by using the calibration instruction unit **209** of the expansion application **204**. Further, when the printing apparatus **102** has the gamma function, the CPU **111** converts the intermediate data into the print data without the gamma correction by using the intermediate data editing unit **207** of the expansion application **204**, and sends the print data to the printing apparatus **102**. On the other hand, when the printing apparatus **102** does not have the gamma correction function, the CPU **111** obtains the gamma coefficient from the printing apparatus

102 by the intermediate data editing unit **207**. Further, the CPU **111** converts the intermediate data subjected to the gamma correction using the obtained gamma coefficient into the print data by the intermediate data editing unit **207**, and sends the print data to the printing apparatus **102**.

[0104] The series of processes described above enable to improve the correction performance based on the calibration result by the expansion application **204** that expands the function of the general-purpose print software **202** that can be commonly used among printing apparatuses provided by a plurality of vendors. Even when the printing apparatus **102** does not have the function using the calibration result, the calibration function can be provided to the user without increasing the cost of the printing apparatus **102**. That is, the expansion application **204** improves the performance of the correction based on the calibration result when the printing apparatus **102** supported by the general-purpose print software **202** has the function using the calibration result and enables the correction when the function concerned is not provided.

[0105] Although the calibration instruction is given in both the sequences in FIGS. **11**A and **11**B, when the check box **610** is not checked, non-execution information indicating that the calibration is not performed is included in the advanced setting information. In this case, when the CPU **111** of the host computer **101** detects the non-execution information from the advanced setting information obtained in the step S**1116** by the calibration instruction unit **209** of the expansion application **204**, the process in the step S**1117** is not performed.

[0106] In addition, although the advanced setting screen in FIG. **6**C is displayed on the display device **120** on the premise that the print system has the software configuration in FIG. **2**B in the first embodiment, this is not limiting. For example, when display of the advanced setting is requested in the step S**1104**, the CPU **111** of the host computer **101** may display the advanced setting screen of FIG. **6**B on the display device **120** by the general-purpose print software **202**. In this case, after the setting on the advanced setting screen in FIG. **6**B is completed, the CPU **111** requests, by the general-purpose print software **202**, the expansion application **204** to display an additional advanced setting screen. Further, the CPU **111** additionally displays the advanced setting screen in FIG. **6**C in which the calibration setting can be set by the print-setting-screen expansion unit **205** of the expansion application **204**.

[0107] In the first embodiment, the CPU **111** of the host computer **101** generates print data based on the intermediate data generated by the general-purpose print software **202** by the intermediate data editing unit **207** of the expansion application **204**. However, the CPU **111** may generate the intermediate data by the intermediate data editing unit **207** itself and generate the print data based on the generated intermediate data.

[0108] A second embodiment will now be described with reference to FIGS. **12** to **16**. In the first embodiment, the calibration is set by the user first, and the print instruction is issued. Subsequently, the CPU**111** of the host computer **101** sends the calibration instruction to the printing apparatus **102** by the expansion application **204**, and causes the printing apparatus **102** to execute the calibration. Next, the CPU **111** switches the process according to the capability information of the printing apparatus **102** by the expansion application **204**.

[0109] Specifically, when the printing apparatus **102** has the gamma correction function, the CPU **111** converts, by the expansion application **204**, the intermediate data into the print data without the correction and sends the print data to the printing apparatus **102** to cause the printing apparatus **102** to perform the gamma correction. On the other hand, when the printing apparatus **102** does not have the gamma correction function, the CPU **111** causes the expansion application **204** to perform the gamma correction on the intermediate data using the gamma coefficient obtained from the printing apparatus **102**. Further, the CPU **111** sends the print data generated based on the intermediate data subjected to the gamma correction to the printing apparatus **102** by the expansion application **204**.

[0110] In the first embodiment, as described above, the calibration instruction is performed only when the calibration setting is set by the user. However, even when the calibration setting is not set

by the user, it is preferable to perform the calibration in some cases. For example, it is a case where a halftone option (screen ruling) is changed. When the halftone option is changed and the screen ruling is changed, the density of halftone dots changes and the dot reproducibility varies, and therefore the gamma characteristics do not match. Therefore, there is a possibility that the gamma coefficient of the screen before the change cannot be used. Therefore, when the halftone option is changed, it is preferable that the calibration setting is automatically set, the gamma coefficient corresponding to the changed halftone option are generated, and the gamma correction is performed with the generated gamma coefficient.

[0111] Thus, in the second embodiment, the expansion application first determines whether the halftone has been changed from a default setting. Then, when the halftone has been changed from the default setting, the expansion application sends a calibration instruction to the printing apparatus. As a result, in printing using the standard driver, even when the calibration setting is not set although the current print setting requires the calibration, a printed matter in which the characteristic unique to the printing apparatus is corrected can be always provided to a user. In addition, similarly to the first embodiment, the expansion application switches whether to perform the gamma correction on the intermediate data according to the capability information of the printing apparatus, and thus it is possible to improve the correction performance. Even when the printing apparatus does not have the gamma correction function, it becomes possible to provide the calibration function to the user.

[0112] The following description of the second embodiment is focused on the differences from the first embodiment. The same configurations and processes as those of the first embodiment are denoted by the same reference numerals in FIGS. **12** to **16** and the descriptions thereof will be omitted because they have been already described in the first embodiment. The second embodiment is different from the first embodiment in five points, that is, the software configuration of the print system, the capability information of the printing apparatus, the print function of the expansion application, the advanced setting screen, and the sequence after the drawing application receives the print setting.

[0113] FIG. **12** is a view illustrating the software configuration of the print system when an expansion application **1201** is associated with the general-purpose print software **202** and a printing apparatus **1202**. The printing apparatus **1202** can switch a halftone process between high screen ruling and low screen ruling. The expansion application **1201** includes the print-setting-screen expansion unit **205**, the print function expansion unit **206**, the notification unit **208**, the shared information **210**, a calibration instruction unit **1203**, and an intermediate data editing unit **1204**.

[0114] The calibration instruction unit **1203** determines whether the halftone has been changed from the default setting, and if the halftone has been changed from the default setting, issues a calibration instruction to the printing apparatus **1202**. The intermediate data editing unit **1204** generates a print data from the intermediate data based on the set halftone option with reference to the advanced setting information. Thus, the halftone which is not provided in the standard driver is reflected to the print data, and the printing apparatus **1202** can perform the image process with the set halftone option. The hardware configuration of the printing apparatus **1202** is the same as that of the printing apparatus **102** in the first embodiment.

[0115] The capability information of the printing apparatus **1202** will be described with reference to FIGS. **13**A and **13**B. FIGS. **13**A and **13**B are views illustrating examples of lists of the capability information obtained from the printing apparatus **1202** as tables. A table **1301** illustrated in FIG. **13**A is an example of a list of capability information when the printing apparatus **1202** has the gamma correction function. A table **1302** illustrated in FIG. **13**B is an example of a list of capability information in a case where the printing apparatus **1202** does not have the gamma correction function. The capability information of the printing apparatus **1202** is stored in the shared information **210**. The tables **1301** and **1302** are obtained by adding a halftone function and default information to the tables **801** and **802** of the first embodiment.

[0116] The default information indicates an option that is initially set for each function when the print setting screen or the advanced setting screen is displayed on the display device **120**. For example, in the case of the table **1301**, “Not Apply” is the default for the calibration function. It is preferable that the calibration is not executed every time of printing unless a print instruction is issued to change the unique characteristics of the printing apparatus **1202**. The reason is that, as described with reference to FIG. **3**, the calibration requires processes, such as output of the density pattern **401**, reading, and generation of the gamma coefficient, and thus an extra time is required until actual printing.

[0117] A list of print functions supported by the expansion application **1201** will be described with reference to FIG. **14**. A table **1401** illustrated in FIG. **14** is an example of a list of print functions supported by the expansion application **1201**. As illustrated in the table **1401**, the halftone function is added to the PDC **203** through the flowchart of the editing process in FIG. **7** by associating the halftone function with the expansion application **1201**. Thus, the halftone function can be displayed on the advanced setting screen. Further, the print data in which the halftone is reflected to the intermediate data generated by the general-purpose print software **202** is generated, and thus the printing apparatus **1202** can perform the image process with the set option of the halftone.

[0118] Next, examples of the print setting screen and advanced setting screen will be described with reference to FIGS. **15**A and **15**B. FIG. **15**A is similar to FIG. **6**A and is a view showing the print setting screen displayed by the drawing application **201**. FIG. **15**B is a view showing the advanced setting screen displayed by the expansion application **1201**. The advanced setting screen in FIG. **15**B is a screen in which a control **1501** and a list **1502** for the halftone are added to the advanced setting screen in FIG. **6**C. In the advanced setting screen in FIG. **15**B, the control **1501** indicates that the low screen ruling is set for the halftone option that is changed from the default setting. The list **1502** is displayed when the user selects the control **1501** by using the pointing device **119**, and indicates other options that can be set for the halftone. Further, the check box **610** is not checked, which indicates that the calibration is not set by the user.

[0119] Next, a sequence of operations of the drawing application **201**, the general-purpose print software **202**, the expansion application **1201**, and the printing apparatus **1202** after the drawing application **201** accepts the print setting will be described with reference to FIG. **16**. FIG. **16** illustrates the sequence (method) in a case where the capability information list of the printing apparatus **1202** is the table **1301**, and the settings illustrated in FIGS. **15**A and **15**B are set as the print setting and advanced setting. Steps other than the steps executed by the printing apparatus **102** in FIG. **16** are achieved by the CPU **111** activating the drawing application **201**, the general-purpose print software **202**, and the expansion application **1201** (programs) in the host computer **101**. On the other hand, the steps executed by the printing apparatus **1202** in FIG. **16** are implemented by the ASIC **135** in the printing apparatus **1202**, but may be implemented by the CPU **131** reading the program stored in the ROM **132** to the RAM **133** and executing the program.

[0120] The sequence in FIG. **16** is obtained by adding a process in a step S**1601** to the sequence in FIG. **11**A. However, in the step S**1107**, the CPU **111** of the host computer **101** accepts the following advanced setting by the print-setting-screen expansion unit **205**. In the case of the advanced setting screen in FIG. **15**B, the print-setting-screen expansion unit **205** accepts the settings set by the user including “Sheet type: Plain paper”, “Sheet size: A**4**”, “Sheet feeding port: Auto”, “Calibration: Not apply”, and “Halftone: Low screen ruling”.

[0121] In a step S**1601**, the CPU **111** determines, by the calibration instruction unit **1203** of the expansion application **1201**, whether the halftone has been changed from the default setting based on the advanced setting information. In this regard, FIG. **16** illustrates the sequence in a case where the settings illustrated in FIGS. **15**A and **15**B are set as the print setting and the detail setting as described above. When the settings illustrated in FIGS. **15**A and **15**B are set, the halftone is changed from the high screen ruling as the default setting to the low screen ruling. Therefore, in the step S**1601**, the CPU **111** determines that the halftone has been changed from the default setting by

the calibration instruction unit **1203** based on the detailed setting information.
[0122] However, as described above, this case has high possibility that the gamma characteristic is different from that in the case of the high screen ruling. Therefore, even if the calibration instruction unit **1203** detects non-execution information indicating that the calibration is not performed from the detailed setting information, the CPU **111** issues the calibration instruction to the printing apparatus **1202** in the step S**1117**. The sequence in the case where the capability information list of the printing apparatus **1202** is the table **1301** and the settings illustrated in FIGS. **15**A and **15**B are set as the print setting and the advanced setting has been described above. When the capability information list of the printing apparatus **1202** is the table **1302** and the printing apparatus **1202** does not have the gamma correction function, the sequence is the same as that in FIG. **16** up to the step S**1119**, and the sequence is the same as that in FIG. **11**B from the step S**1120**.
[0123] The series of processes described above enable to improve the correction performance based on the calibration result by the expansion application **1201** that expands the function of the general-purpose print software **202** that can be commonly used among printing apparatuses provided by a plurality of vendors. Even when the printing apparatus **1202** does not have the function using the calibration result, the calibration function can be provided to the user without increasing the cost of the printing apparatus **1202**. That is, the expansion application **1201** improves the performance of the correction based on the calibration result when the printing apparatus **1202** supported by the general-purpose print software **202** has the function using the calibration result and enables the correction when the function concerned is not provided.
[0124] Further, in the second embodiment, even when the advanced setting for not performing the calibration is set, when the option of the printing function requiring the calibration is changed, the calibration instruction is issued. Specifically, even when the check box **610** is not checked and the advanced setting for not performing the calibration is set, when the halftone option, which is a print function requiring the calibration, has been changed, the calibration instruction is issued. In this way, in the second embodiment, even when the advanced setting for not performing the calibration is set, the printed matter in which the characteristic unique to the printing apparatus **1202** is corrected can be always provided to the user. Further, since the calibration instruction is issued only when the option of the printing function requiring the calibration is changed, and the calibration instruction is not issued every time of printing, it is possible to suppress the unnecessary calibration instruction.
[0125] In the second embodiment, the CPU **111** of the host computer **101** instructs the calibration by the calibration instruction unit **1203** of the expansion application **1201** when it is determined that the halftone has been changed from the default setting. However, the CPU **111** may cause the printing apparatus **1202** to hold the halftone option and the gamma coefficient in association with each other, and issue the calibration instruction by the calibration instruction unit **1203** when the current halftone option is different from the held one. When a setting of an option of a function (for example, the sheet type) for changing the characteristic unique to the printing apparatus **1202** other than the halftone is changed, the CPU **111** may issue the calibration instruction by the calibration instruction unit **1203**.
[0126] A third embodiment will now be described with reference to FIGS. **17** to **22**. In the first and second embodiments, the calibrations of the printing apparatuses **102** and **1202** are completed without requiring a user operation. In this regard, there are a plurality of methods for calibration performed in the printing apparatus. For example, as in the first and second embodiment, there is the calibration method in which the density patches are output to the intermediate transfer belt of the printing apparatus or a sheet and the density patches are read by the sensor in the printing apparatus. Such a method does not require a user operation.
[0127] In addition, there is a calibration method in which density patches are output to a sheet by a printing apparatus, the sheet is discharged, and the sheet is scanned by a reader attached to the printing apparatus to read the density patches. In such a method, user operations, such as setting of

the sheet to the reader and an instruction of scanning, are required. When a user goes to the printing apparatus after the print instruction, it is preferable that printing has already been completed and the user can obtain a printed matter. However, if the calibration requiring a user operation is set, a user must perform the calibration operation before the printed matter is obtained, which is inconvenient. Further, the user obtains the printed matter after waiting for completion of the calibration after the calibration operation is performed. Therefore, extra time is required to obtain the printed matter.

[0128] Therefore, in the third embodiment, the expansion application determines whether the calibration requiring an actual machine operation has been set. When the calibration requiring the actual machine operation is set, the expansion application displays a warning screen for urging a user to change the setting to the calibration not requiring the actual machine operation. Thus, when the user changes the setting to the calibration in which the actual machine operation is unnecessary, it is possible to provide the calibration function without causing the user to take extra time and effort in the printing using the standard driver. In addition, similarly to the first and second embodiments, since the expansion application switches whether to perform the gamma correction on the intermediate data according to the capability information of the printing apparatus, and thus it is possible to improve the correction performance. Even when the printing apparatus does not have the gamma correction function, it becomes possible to provide the calibration function to the user.

[0129] The following description of the third embodiment is focused on the differences from the first embodiment. The same configurations and processes as those of the first embodiment are denoted by the same reference numerals in FIGS. **17** to **22** and the descriptions thereof will be omitted because they have been already described in the first embodiment. The third embodiment is different from the first embodiment in six points, that is, the software configuration of the print system, the capability information of the printing apparatus, the printing function of the expansion application, the advanced setting screen, the sequence after the drawing application receives the print setting, and a warning screen. In the third embodiment, the configuration related to the halftone in the second embodiment may be provided to perform the process related to the halftone in second embodiment.

[0130] FIG. **17** is a view showing a software configuration of a print system in which an expansion application **1701** is associated with the general-purpose print software **202** and a printing apparatus **1702**. The printing apparatus **1702** is equipped with a plurality of calibration methods. The printing apparatus **1702** is equipped with a calibration method that does not require an actual machine operation of a user, such as outputting the density patches to the intermediate transfer belt and reading the output density patches with the sensor. Further, the printing apparatus **1702** is also equipped with a calibration method in which the density patches output to the sheet is read by the reader by the actual machine operation of user. Hereinafter, the calibration method that does not require an actual machine operation of a user is also referred to as “simple calibration”, and the calibration that requires an actual machine operation of a user is also referred to as “fine calibration”.

[0131] The expansion application **1701** also includes the print-setting-screen expansion unit **205**, the print function expansion unit **206**, the intermediate data edit unit **207**, the notification unit **208**, the shared information **210**, and a calibration instructing unit **1703**. The calibration instructing unit **1703** displays a warning screen for a user when the calibration requiring the actual machine operation of a user is set. Further, the user can change the setting of the calibration to a setting that does not require the actual machine operation of the user, or can accept that the calibration that requires the actual machine operation of the user is set, on the warning screen. The hardware configuration of the printing apparatus **1702** is the same as that of the printing apparatus **102** in the first embodiment.

[0132] The capability information of the printing apparatus **1702** will be described with reference

to FIGS. **18**A and **18**B. FIGS. **18**A and **18**B are views illustrating examples of lists of capability information obtained from the printing apparatus **1702** as tables. A table **1801** illustrated in FIG. **18**A is an example of a list of capability information in the case where the printing apparatus **1702** has the gamma correction function. A table **1802** illustrated in FIG. **18**B is an example of a list of capability information in a case where the printing apparatus **1702** does not have the gamma correction function. The capability information of the printing apparatus **1702** is stored in the shared information **210**. The tables **1801** and **1802** are obtained by replacing the option "Apply" of the calibration in the tables **801** and **802** in the first embodiment with the options "simple calibration" and "fine calibration".

[0133] A list of printing functions supported by the expansion application **1701** will be described with reference to FIG. **19**. A table **1901** illustrated in FIG. **19** is an example of a list of print functions supported by the expansion application **1701**. As illustrated in the table **1901**, the function of the calibration is added to the PDC **203** through the flowchart of the editing process in FIG. **7** by associating the options of the simple calibration and the fine calibration with the expansion application **1701**. This enables the calibration function to be displayed on the advanced setting screen.

[0134] Next, examples of the print setting screen and the advanced setting screen will be described with reference to FIG. **20**A and FIG. **20**B. FIG. **20**A is similar to FIG. **6**A and is a view illustrating the print setting screen displayed by the drawing application **201**. FIG. **20**B is a view illustrating the advanced setting screen displayed by the expansion application **1701**. The advanced setting screen in FIG. **20**B is provided with a control **2001** and a list **2002** for the calibration instead of the check box **610** in the advanced setting screen in FIG. **6**C. The control **2001** in the advanced setting screen in FIG. **20**B indicates that the fine calibration is set as the option of the calibration. The list **2002** is displayed when the user selects the control **2001** by using the pointing device **119** and indicates other options that can be set for the calibration.

[0135] Next, sequences of operations of the drawing application **201**, the general-purpose print software **202**, the expansion application **1701**, and the printing apparatus **1702** after the drawing application **201** accepts the print setting will be described with reference to FIGS. **21**A and **21**B. FIG. **21**A illustrates the sequence (method) in a case where the capability information list of the printing apparatus **1702** is the table **1801**, the calibration is set with the option of the fine calibration, and a "Yes" button is selected on a warning screen described below. FIG. **21**B illustrates the sequence (method) in a case where the capability information list of the printing apparatus **1702** is the table **1801**, the calibration is set with the option of the fine calibration, and a "No" button is selected on the warning screen described below.

[0136] Steps other than the steps executed by the printing apparatus **1702** in FIGS. **21**A and **21**B are achieved by the CPU **111** activating the drawing application **201**, the general-purpose print software **202**, and the expansion application **1701** (programs) in the host computer **101**. On the other hand, the steps executed by the printing apparatus **1702** in FIGS. **21**A and **21**B are implemented by the ASIC **135** in the printing apparatus **1702**, but may be implemented by the CPU **131** reading the program stored in the ROM **132** to the RAM **133** and executing the program.

[0137] The sequence in FIG. **21**A is obtained by adding processes in steps S**2101** and S**2102** to the sequence in FIG. **11**A. In the step S**2101**, the CPU **111** of the host computer **101** determines, by the calibration instructing unit **1703** of the expansion application **1701**, whether the option of the calibration requiring the actual machine operation has been set based on the advanced setting information. In this regard, FIG. **21**A illustrates the sequence in the case where the calibration is set with the option of the fine calibration as described above. Therefore, in the step S**2101**, the CPU **111** determines, by the calibration instructing unit **1703**, that the option of the calibration requiring the real machine operation is set. Next, in the step S**2102**, the CPU **111** displays the warning screen on the display device **120** by the calibration instructing unit **1703**.

[0138] The warning screen will be described below with reference to FIG. **22**. FIG. **22** is a view

illustrating an example of the warning screen **2201** displayed on the display device **120**. The warning screen **2201** displays a message indicating that an actual machine operation of a user is required before printing. The warning screen **2201** further includes a first control **2202** and a second control **2203**. The first control **2202** is a "Yes" button for a user to change the option of the calibration to the simple calibration that does not require the actual machine operation of the user. The second control **2203** is a "No" button for a user to agree that the option of the calibration is set in the fine calibration requiring the actual machine operation of the user.

[0139] As described above, FIG. **21**A illustrates the sequence in the case where the first control **2202** ("Yes" button) is selected on the warning screen **2201**. Therefore, in the sequence in FIG. **21**A, the processes from the step S**1117** are executed in the same manner as in the sequence in FIG. **11**A. The above is the description of the sequence in the case where the list of capability information of the printing apparatus **1702** is the table **1801**, the calibration is set with the option of the fine calibration, and the first control **2202** ("Yes" button) is selected on the warning screen **2201**. When the capability information list of the printing apparatus **1702** is the table **1802**, the sequence is the same as that in FIG. **11**A up to the step S**1119**, and the sequence is the same as that in FIG. **11**B form the step S**1120**.

[0140] The sequence of FIG. **21**B is obtained by adding processes in the steps S**2101** and S**2102** to the sequence in FIG. **11**A and further replacing the process in the step S**1118** with processes in steps S**2103** to S**2106**. The descriptions of the steps S**2101** and S**2102** has already been given in the description of the sequence in FIG. **21**A, and therefore will be omitted. FIG. **21**B illustrates the sequence in the case where the second control **2203** ("No" button) is selected on the warning screen **2201** as described above. Therefore, in the sequence in FIG. **21**B, processes in the steps S**2103** to S**2106** are executed in place of the process in the step S**1118** in the sequence in FIG. **21**A.

[0141] In the step S**2103**, the ASIC **135** of the printing apparatus **1702** outputs the density patches. Thus, the density patches are printed on a sheet. Subsequently, in the step S**2104**, the ASIC **135** of the printing apparatus **1702** accepts the calibration operations by the user. The calibration operations by the user include an operation to set the sheet on which the density patches are printed to the reader and an operation to instruct the reader to scan the sheet. Next, in the step S**2105**, the ASIC **135** of the printing apparatus **1702** scans the sheet with the reader and reads the density patches. Subsequently, in the step S**2106**, the ASIC **135** of the printing apparatus **1702** generates gamma coefficient that matches the target values. Thereafter, in the sequence in FIG. **21**B, the respective processes from the step S**1119** are executed in the same manner as in the sequence in FIG. **21**A. The above is the description of the sequence in the case where the capability information list of the printing apparatus **1702** is the table **1801**, the calibration is set with the option of the fine calibration, and the second control **2203** ("No" button) is selected on the warning screen **2201**. When the capability information list of the printing apparatus **1702** is the table **1802**, the sequence is the same as that in FIG. **21**B up to the step S**1119** and the sequence is the same as that in FIG. **11**B from the step S**1120**.

[0142] The series of processes described above enable to improve the correction performance based on the calibration result by the expansion application **1701** that expands the function of the general-purpose print software **202** that can be commonly used among printing apparatuses provided by a plurality of vendors. Even when the printing apparatus **1702** does not have the function using the calibration result, the calibration function can be provided to the user without increasing the cost of the printing apparatus **1702**. That is, the expansion application **1701** improves the performance of the correction based on the calibration result when the printing apparatus **1702** supported by the general-purpose print software **202** has the function using the calibration result and enables the correction when the function concerned is not provided.

[0143] Further, in the third embodiment, when the option of the calibration requiring the actual machine operation of the user is set, the user is warned by the warning screen **2201** and is prompted to change the setting to the option of the calibration not requiring the actual machine operation of

the user. Thus, when the setting is changed to the calibration not requiring the actual machine operation of the user, it is possible to provide the calibration function without causing the user to take extra time and effort in the printing using the standard driver.

OTHER EMBODIMENTS

[0144] Embodiment(s) of the present disclosure can also be realized by a computer of a system or apparatus that reads out and executes computer executable instructions (e.g., one or more programs) recorded on a storage medium (which may also be referred to more fully as a 'non-transitory computer-readable storage medium') to perform the functions of one or more of the above-described embodiment(s) and/or that includes one or more circuits (e.g., application specific integrated circuit (ASIC)) for performing the functions of one or more of the above-described embodiment(s), and by a method performed by the computer of the system or apparatus by, for example, reading out and executing the computer executable instructions from the storage medium to perform the functions of one or more of the above-described embodiment(s) and/or controlling the one or more circuits to perform the functions of one or more of the above-described embodiment(s). The computer may comprise one or more processors (e.g., central processing unit (CPU), micro processing unit (MPU)) and may include a network of separate computers or separate processors to read out and execute the computer executable instructions. The computer executable instructions may be provided to the computer, for example, from a network or the storage medium. The storage medium may include, for example, one or more of a hard disk, a random-access memory (RAM), a read only memory (ROM), a storage of distributed computing systems, an optical disk (such as a compact disc (CD), digital versatile disc (DVD), or Blu-ray Disc (BD)™), a flash memory device, a memory card, and the like.

[0145] While the present disclosure includes exemplary embodiments, it is to be understood that the disclosure is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

[0146] This application claims the benefit of Japanese Patent Application No. 2024-017707, filed Feb. 8, 2024, which is hereby incorporated by reference herein in its entirety.

Claims

1. A non-transitory computer-readable storage medium storing an application program causing a computer of an information processing apparatus, which executes general-purpose print software capable of generating print data printable by printing apparatuses provided by different vendors, to execute a control method comprising: accepting setting related to calibration; instructing a printing apparatus connected to the information processing apparatus to execute the calibration in accordance with the setting related to the calibration; obtaining capability information of the printing apparatus; determining whether the printing apparatus includes a module that uses a result of the calibration based on the capability information of the printing apparatus; generating print data based on intermediate data generated by the general-purpose print software without correcting the intermediate data in a case where the printing apparatus includes a module that uses the result of the calibration; generating print data based on corrected intermediate data that is obtained by correcting the intermediate data using the result of the calibration obtained from the printing apparatus in a case where the printing apparatus does not include a module that uses the result of the calibration; and sending the print data generated to the printing apparatus.

2. The non-transitory computer-readable storage medium according to claim 1, wherein the result of the calibration is a correction coefficient for correcting characteristic unique to the printing apparatus.

3. The non-transitory computer-readable storage medium according to claim 2, wherein the correction coefficient is a gamma coefficient.

4. The non-transitory computer-readable storage medium according to claim 1, wherein the control method further comprises: accepting a setting related to a function that changes a characteristic unique to the printing apparatus; determining whether the setting related to the function that changes the characteristic unique to the printing apparatus has been changed; and instructing the printing apparatus to execute the calibration in a case where the setting related to the function that changes the characteristic unique to the printing apparatus is changed regardless of the setting related to the calibration accepted.

5. The non-transitory computer-readable storage medium according to claim 4, wherein the setting related to the function that changes the characteristic unique to the printing apparatus is a setting related to halftone.

6. The non-transitory computer-readable storage medium according to claim 5, wherein the case where the setting related to the function that changes the characteristic unique to the printing apparatus is changed is a case where a default setting of the halftone is changed.

7. The non-transitory computer-readable storage medium according to claim 1, wherein the control method further comprises: determining whether the calibration related to the setting accepted requires an actual machine operation of a user; and displaying a warning screen in a case where the calibration related to the setting accepted requires the actual machine operation of the user.

8. The non-transitory computer-readable storage medium according to claim 7, wherein the warning screen includes a first control for the user to change the calibration related to the setting accepted to a calibration that does not require the actual machine operation of the user, and a second control for the user to agree that the calibration related to the setting accepted requires the actual machine operation of the user.

9. A method performed by an information processing apparatus executing general-purpose print software capable of generating print data printable by printing apparatuses provided by different vendors, the method comprising: accepting setting related to calibration; instructing a printing apparatus connected to the information processing apparatus to execute the calibration in accordance with the setting related to the calibration; obtaining capability information of the printing apparatus; determining whether the printing apparatus includes a module that uses a result of the calibration based on the capability information of the printing apparatus; generating print data based on intermediate data generated by the general-purpose print software without correcting the intermediate data in a case where the printing apparatus includes a module that uses the result of the calibration; generating print data based on corrected intermediate data that is obtained by correcting the intermediate data using the result of the calibration obtained from the printing apparatus in a case where the printing apparatus does not include a module that uses the result of the calibration; and sending the print data generated to the printing apparatus.

10. An information processing apparatus executing general-purpose print software capable of generating print data printable by printing apparatuses provided by different vendors, the information processing apparatus comprising: a memory device that stores a set of instructions; and at least one processor that executes the set of instructions to: accept setting related to calibration; instruct a printing apparatus connected to the information processing apparatus to execute the calibration in accordance with the setting related to the calibration; obtain capability information of the printing apparatus; determine whether the printing apparatus includes a module that uses a result of the calibration based on the capability information of the printing apparatus; generate print data based on intermediate data generated by the general-purpose print software without correcting the intermediate data in a case where the printing apparatus includes a module that uses the result of the calibration; generate print data based on corrected intermediate data that is obtained by correcting the intermediate data using the result of the calibration obtained from the printing apparatus in a case where the printing apparatus does not include a module that uses the result of the calibration; and send the print data generated to the printing apparatus.