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Control method for information processing apparatus and non-transitory computer-readable storage medium storing program

Abstract

A control method for an information processing apparatus includes receiving an input of first authentication information, performing authentication based on the first authentication information according to a program for controlling a first display apparatus, when the authentication based on the first authentication information is successful, transmitting a connection request including the first authentication information to the first display apparatus via a communication network, and, when the authentication by the first display apparatus is successful, connecting to the first display apparatus according to the program.

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Background/Summary

(1) The present application is based on, and claims priority from JP Application Serial Number 2022-052158, filed Mar. 28, 2022, the disclosure of which is hereby incorporated by reference herein in its entirety.

BACKGROUND

1. Technical Field

(2) The present disclosure relates to a control method for an information processing apparatus and a non-transitory computer-readable storage medium storing a program.

2. Related Art

(3) There has been proposed a method for authentication processing in a system in which an information processing apparatus such as a personal computer executes communication with a display apparatus. For example, JP-A-2016-71136 (Patent Literature 1) discloses a method in which, when authentication information of a user input in a projector is registered in an authentication server, the authentication server specifies a personal computer corresponding to the user and transmits, with the specified personal computer, data to the projector to enable the projector to project a screen.

(4) As described in Patent Literature 1, it is complicated for the user to be requested to input the authentication information in the display apparatus.

SUMMARY

(5) An aspect of the present disclosure is a control method for an information processing apparatus including: receiving an input of first authentication information; performing authentication based on the first authentication information according to a program for controlling a first display apparatus; when the authentication based on the first authentication information is successful, transmitting a connection request including the first authentication information to the first display apparatus via a communication network; and, when the authentication by the first display apparatus is successful, connecting to the first display apparatus according to the program.

(6) Another aspect of the present disclosure is a non-transitory computer-readable storage medium storing a program for controlling a display apparatus, the program causing an information processing apparatus to execute processing including: receiving an input of authentication information; performing the authentication based on the authentication information; when the authentication based on the authentication information is successful, transmitting a connection request including the authentication information to the display apparatus via a communication network; and, when the authentication by the display apparatus is successful, connecting to the display apparatus.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

- (1) FIG. 1 is a diagram showing a configuration of a display system.
- (2) FIG. 2 is a diagram showing a configuration of a projector in a first embodiment.
- (3) FIG. 3 is a diagram showing a configuration of a PC in the first embodiment.
- (4) FIG. 4 is a flowchart showing an operation of the projector in the first embodiment.
- (5) FIG. 5 is a flowchart showing an operation of the PC in the first embodiment.
- (6) FIG. 6 is a diagram showing an example of a screen displayed by the PC.
- (7) FIG. 7 is a diagram showing a configuration of a PC in a second embodiment.
- (8) FIG. 8 is a flowchart showing an operation of the PC in the second embodiment.
- (9) FIG. 9 is a diagram showing a configuration of a PC in a third embodiment.
- (10) FIG. 10 is a flowchart showing an operation of the PC in the third embodiment.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

1. First Embodiment

(11) Embodiments of the present disclosure are explained below with reference to the drawings.

(12) 1-1. Configuration of a Display System

(13) FIG. 1 is a diagram showing a configuration of a display system **100**.

(14) The display system **100** includes one or a plurality of PCs (Personal Computers) **1** and a plurality of projectors **2**. The number of projectors **2** and the number of PCs **1** are not limited. In FIG. 1, as an example, a configuration of the display system **100** including one PC **1** and five projectors **2A**, **2B**, **2C**, **2D**, and **2E** is shown. When the projectors **2A** and **2B** are not distinguished, the projectors **2A** and **2B** are described as projectors **2**. The projectors **2** correspond to an example

of the display apparatus. The PC **1** corresponds to an example of the information processing apparatus.

(15) In FIG. **1**, network addresses in a communication network NW, specifically, IP (Internet Protocol) addresses are illustrated for the five projectors **2**. IP addresses of the projectors **2** are explained below.

(16) The projectors **2** and the PC **1** are connected to be capable of performing data communication via the communication network NW. The communication network NW may be a LAN (Local Area Network) or may be a global network including a leased line, a public line network, and the Internet. In this embodiment, an example is explained in which the communication network NW is configured by a LAN. The communication network NW may be a wireless communication network such as Wi-Fi. Wi-Fi is a registered trademark.

(17) The PC **1** connects to the projectors **2** via the communication network NW and controls an operation relating to projection of the projectors **2**. The PC **1** shown in FIG. **1** is a notebook PC. However, this is an example. For example, the PC **1** may be a desktop PC, a tablet PC, or a smartphone.

(18) In this embodiment, the projectors **2** project videos according to the control of the PC **1**. The projectors **2** projecting the videos correspond to an example of the display. For example, the projectors **2** project videos onto a projection surface such as a screen based on video data output by the PC **1** via the communication network NW. The PC **1** connects to the projectors **2** to thereby perform control for causing the projectors **2** to start projection, control for performing setting of videos to be projected by the projectors **2**, control for causing the projectors **2** to stop the projection, and the like.

(19) The projectors **2** project image lights onto the projection surface to thereby display videos on the projection surface. The projection surface may be a curtain-like screen or may be a wall surface of a building or a surface of an installed object.

(20) 1-2. Configuration of the Projector

(21) FIG. **2** is a diagram showing a configuration of the projectors **2** in the first embodiment. A basic configuration is common to the projectors **2** included in the display system **100**.

(22) A projector **2A** includes a PJ (Projector) controller **21**. The PJ controller **21** includes a PJ processor **210** configured by a CPU (Central Processing Unit), an MPU (Micro-processing unit), or the like and a PJ storage **220**. The PJ controller **21** executes a program with the PJ processor **210** to thereby control the units of the projector **2**.

(23) The PJ storage **220** is a nonvolatile storage device configured by a semiconductor element such as a flash memory. The PJ storage **220** stores programs to be executed by the PJ processor **210**, data to be processed by the PJ processor **210**, and the like. The PJ storage **220** stores, for example, a control program **221**, setting information **222**, apparatus information **223**, and authentication information **224**.

(24) The apparatus information **223** includes information concerning the projector **2** and specifically is information for an apparatus connected to the projector **2** via the communication network NW to identify the projector **2**. The apparatus information **223** includes, for example, a network address of the projector **2** in the communication network NW. The apparatus information **223** includes, for example, a name given to the projector **2** in advance. The name of the projector **2** may be common to the plurality of projectors **2**. However, it is preferable that a different name is given to each of the projectors **2** connected to the same communication network NW.

(25) The PJ storage **220** may include a volatile storage region and configure a work area for temporarily storing programs to be executed by the PJ processor **210** and processing target data.

(26) The PJ processor **210** reads out and executes the control program **221** stored by the PJ storage **220** to thereby execute various kinds of processing through cooperation of hardware and software.

(27) The projector **2** includes a projecting unit **20** that projects image light onto the projection surface. The projecting unit **20** is connected to the PJ controller **21** by a bus **29**. The projecting unit

20 includes, for example, a light source, a light modulation device, and a projection optical system. The light source is lit according to the control of the PJ controller **21** and emits light toward the light modulation device. A specific configuration of the light source is not limited. Examples of the light source includes lamps such as a halogen lamp, a xenon lamp, and an ultrahigh pressure mercury lamp and solid-state light sources such as an LED and a laser light source. The light modulation device modulates the light emitted by the light source. A specific configuration of the light modulation device is not limited. For example, the light modulation device can be configured by a transmissive liquid crystal panel, a reflective liquid crystal panel, or a digital mirror device (Digital Micromirror Device). The projection optical system included in the projecting unit **20** includes a lens, a mirror, and a prism for focusing image light modulated by the light modulation device on the projection surface.

(28) The projecting unit **20** may include a light source driving circuit that supplies electric power to the light source and a driving circuit that causes the light modulation device to execute drawing. The projecting unit **20** may include a zoom mechanism and a focus adjusting mechanism that performs adjustment of a focus.

(29) The projector **2** includes a PJ communication unit **24**, a remote controller light receiver **25**, an operation panel **26**, a sound processor **27**, and an image processor **28**. These units are connected to the PJ controller **21** via the bus **29**.

(30) The PJ communication unit **24** is a communication device that is connected to the communication network NW and executes communication with the PC **1** via the communication network NW. The PJ communication unit **24** includes, for example, a connector to which an Ethernet cable is connected and a communication circuit that transmits and receives signals. Ethernet is a registered trademark. The PJ communication unit **24** may be a wireless communication device that executes wireless communication such as Wi-Fi.

(31) The remote controller light receiver **25** receives a radio signal transmitted by a not-shown remote control device. The remote controller light receiver **25** decodes the received signal to thereby generate an operation signal and outputs the operation signal to the PJ controller **21**. The radio signal received by the remote controller light receiver **25** is, for example, an infrared signal but may be another signal.

(32) The operation panel **26** is provided in a housing of the projector **2** and includes various switches operable by a user. The operation panel **26** outputs an operation signal to the PJ controller **21** according to a switch being operated.

(33) The sound processor **27** is connected to a not-shown speaker. The sound processor **27** outputs sound from a speaker according to the control of the PJ controller **21**.

(34) The image processor **28** executes, according to the control of the PJ controller **21**, image processing for video data input from the PC **1** or a not-shown image source. Examples of the image processing executed by the image processor **28** include resolution conversion processing, resize processing, geometric correction processing, digital zoom processing, luminance adjustment processing, projecting position correction processing. For example, when the plurality of projectors **2** are disposed side by side and execute tiling projection, the image processor **28** executes edge blending processing. A type of the image processing executed by the image processor **28** is designated by the PJ controller **21**. Parameters and data for arithmetic operations used for the image processing by the image processor **28** are input to the image processor **28** from the PJ controller **21**. The image processor **28** generates a display signal for displaying a video after the image processing and outputs the display signal to the light modulation device of the projecting unit **20**. The PJ controller **21** sets, based on the setting information **222**, the parameters and the data for the arithmetic operations for the image processing by the image processor **28**.

(35) The PJ controller **21** receives input operation of the user with the remote controller light receiver **25** or the operation panel **26**. The PJ controller **21** causes the projecting unit **20** to project a video according to input operation of the user. For example, the PJ controller **21** controls the image

processor **28** to execute image processing for video data and controls the light source and the light modulation device of the projecting unit **20** to thereby cause the projecting unit **20** to project a video processed by the image processor **28** onto the projection surface. The PJ controller **21** controls the sound processor **27** to output sound from the not-shown speaker.

(36) The PJ controller **21** executes authentication processing when the projector **2** is started to be used. The authentication information **224** is used for the authentication processing. The authentication information **224** is authentication information of the projector **2** and is configured by, for example, a combination of a user ID and a password. The authentication information **224** can be set for each of the projectors **2**. For example, the projectors **2A**, **2B**, **2C**, **2D**, and **2E** may respectively include different pieces of authentication information **224**.

(37) The PJ controller **21** executes the authentication processing based on the authentication information **224** when the PC **1** accesses the projector **2** via the communication network NW. Specifically, the PJ controller **21** receives authentication information transmitted by the PC **1** and collates the received authentication information and the authentication information **224**. When the authentication information received from the PC **1** and the authentication information **224** satisfy a predetermined condition, the PJ controller **21** determines that the PJ controller **21** has succeeded in authentication of the PC **1**. The predetermined condition means that, for example, the authentication information received from the PC **1** and the authentication information **224** coincide. When the PJ controller **21** has succeeded in the authentication, the PC **1** becomes capable of controlling the projector **2** with an application program **122** explained below.

(38) The PJ controller **21** may perform the authentication processing when the user directly operates a remote controller or the operation panel **26** of the projector **2** and uses the projector **2**. In this case, the PJ controller **21** executes the authentication by collating information input by the remote controller or the operation panel **26** with the authentication information **224**. When the PJ controller **21** has succeeded in the authentication processing, the user becomes capable of using the projector **2**.

(39) The image processor **28** may be configured by, for example, an integrated circuit. The integrated circuit of this type includes an LSI, an ASIC (Application Specific Integrated Circuit), a PLD (Programmable Logic Device), an FPGA (Field-Programmable Gate Array), and an SoC (System-on-a-chip). An analog circuit may be included in a part of a configuration of the integrated circuit. The integrated circuit and the PJ controller **21** may be integrated.

(40) The projector **2** may include, in addition to the PJ communication unit **24**, an interface connected to equipment functioning as a video source. For example, the projector **2** includes an interface including communication hardware such as a connector and an interface circuit conforming to a predetermined communication standard. The interface is a digital interface such as an HDMI (High-Definition Multimedia Interface), a Displayport, an HDBaseT, or a USB (Universal Serial Bus). HDMI and HDBaseT are registered trademarks. The projector **2A** may include, as an interface, an analog video terminal such as an RCA terminal, a VGA terminal, an S terminal, or a D terminal and may be capable of receiving an analog video signal.

(41) 1-3. Configuration of the PC

(42) FIG. **3** is a diagram showing a configuration of a PC **1** in the first embodiment.

(43) The PC **1** includes a PC controller **11**, a display **14**, a PC input unit **15**, and a PC communication unit **16**. These units are connected to one another by a bus **17**.

(44) The PC controller **11** includes a PC processor **110** and a PC storage **120**. The PC processor **110** is configured by a processor such as a CPU or an MPU. The PC controller **11** executes programs with the PC processor **110** to thereby control the units of the PC **1**.

(45) The PC storage **120** is a storage device that stores data in a nonvolatile manner with a flash memory, a magnetic recording medium, an optical recording medium, or the like. The PC storage **120** stores programs to be executed by the PC processor **110**, data to be processed by the PC processor **110**, and the like. The PC storage **120** stores, for example, an OS (Operating System)

121, an application program **122**, and PC authentication information **123**. The OS **121** is basic control software for controlling the PC **1** and provides a platform on which the application program **122** is executed. The application program **122** is a program for including a function of outputting a video to the projector **2**. The PC authentication information **123** is authentication information used for authentication for the user, who operates the PC **1**, to use the application program **122**.

(46) The display **14** includes an LCD (Liquid Crystal Display) panel. The display **14** may include a display panel such as an LED (Light Emitting Diode) panel or an OLED (Organic LED) panel. The display **14** displays an image and a video according to the control of the PC controller **11**. The display **14** may be a display device connected to the outside of the PC **1**.

(47) The PC input unit **15** includes an input device operated by the user of the PC **1** or is connected to the input device. The input device is a switch panel including operation switches, a touch panel, a mouse, a keyboard, or the like. The PC input unit **15** detects operation of the user on the input device and outputs a detection result to the PC controller **11**.

(48) The PC communication unit **16** is a communication device that performs communication according to a predetermined communication standard. The PC communication unit **16** is a communication device that is connected to the communication network NW and executes communication with the projector **2** via the communication network NW. The PC communication unit **16** includes, for example, a connector to which an Ethernet cable is connected and a communication circuit that transmits and receives signals. The PC communication unit **16** may be a wireless communication device that executes wireless communication such as Wi-Fi.

(49) When starting the application program **122** according to operation of the user, the PC controller **11** executes authentication processing based on the PC authentication information **123**. The PC authentication information **123** is authentication information set in advance in the PC **1** and is configured by, for example, a combination of a user ID and a password. The PC authentication information **123** can be set for each of the PCs **1**. The PC authentication information **123** is authentication information corresponding to the application program **122**. Accordingly, in a configuration in which the PC **1** is capable of executing a plurality of application programs **122**, different PC authentication information **123** may be set for each of the application programs **122**. In this case, the PC **1** stores a plurality of pieces of PC authentication information **123** in the PC storage **120**. The PC storage **120** stores the respective pieces of PC authentication information **123** and the application programs **122** in association with each other.

(50) The PC controller **11** receives an input of the user with the PC input unit **15**. When execution of the application program **122** is instructed by the input of the user, the PC controller **11** receives, with the PC input unit **15**, an input of authentication information by the user. The PC controller **11** collates the input authentication information and the PC authentication information **123**. When the input authentication information and the PC authentication information **123** satisfy a predetermined condition, the PC controller **11** determines that the PC controller **11** has succeeded in authentication. The predetermined condition means that, for example, the input authentication information and the PC authentication information **123** coincide. When succeeding the authentication, the PC controller **11** executes the application program **122**.

(51) The PC controller **11** executes the application program **122** to thereby control the projector **2**. The control of the projector **2** by the application program **122** includes, for example, control for causing the projector **2** to start projection, control for performing setting of a video projected by the projector **2**, and control for causing the projector **2** to stop the projection.

(52) In this embodiment, in a state in which the PC **1** and the projector **2** are connected to the communication network NW, the PC **1** searches for the projector **2** with which the PC **1** can communicate. The PC **1** attempts an access to the projector **2** detected by the search with a function of the application program **122** and requests the projector **2** to execute authentication processing. The projector **2** executes the authentication processing according to the access by the PC **1**. This operation is explained below.

(53) 1-4. Operation of the Projector

(54) FIG. 4 is a flowchart showing an operation of the projector 2 in the first embodiment.

(55) When receiving search information from the PC 1 (step SA11), the PJ controller 21 transmits a response including the device information 223 to the PC 1 (step SA12).

(56) Thereafter, the PC 1 receives the response and transmits an authentication request to the projector 2 as explained below. The PJ controller 21 receives the authentication request with the PJ communication unit 24 and accepts the authentication request (step SA13). The authentication request includes authentication information.

(57) The PJ controller 21 executes authentication based on the authentication information 224 in response to the authentication request (step SA14). Specifically, the PJ controller 21 collates the authentication information included in the authentication request received from the PC 1 and the authentication information 224. When the received authentication information and the authentication information 224 satisfy a predetermined condition, the PJ controller 21 determines that the PJ controller 21 has succeeded in authentication of the PC 1. When the received authentication information and the authentication information 224 do not satisfy the predetermined condition, the PJ controller 21 determines that the PJ controller 21 has failed in the authentication.

(58) The PJ controller 21 determines a result of the authentication (step SA15). When failing in the authentication (NO in step SA15), the PJ controller 21 ends this processing.

(59) When succeeding in the authentication (YES in step SA15), the PJ controller 21 transmits a response indicating the authentication success to the PC 1 (step SA16). Thereafter, the PJ controller 21 executes connection processing in response to a request from the PC 1 (step SA17). The connection processing includes processing for establishing communication between the PC 1 and the projector 2. The connection processing includes processing for bringing, with the function of the application program 122 executed by the PC 1, the PC 1 into a state in which the PC 1 is capable of controlling the projector 2.

(60) 1-5. Operation of the PC

(61) FIG. 5 is a flowchart showing an operation of the PC 1 in the first embodiment.

(62) The PC controller 11 starts the application program 122 according to operation of the user received by the PC input unit 15 (step SB11). The PC controller 11 receives, with the PC input unit 15, an input of authentication information by the user (step SB12). In step SB 12, the PC controller 11 displays, with the function of the application program 122, on the display 14, a message for requesting the input of the authentication information and an input box.

(63) The PC controller 11 executes authentication processing based on the PC authentication information 123 (step SB13). In step SB13, the PC controller 11 collates the authentication information received in step SB12 and the PC authentication information 123. When the input authentication information and the PC authentication information 123 satisfy a predetermined condition, the PC controller 11 determines that the PC controller 11 has succeeded in authentication. When the input authentication information and the PC authentication information 123 does not satisfy the predetermined condition, the PC controller 11 determines that the PC controller 11 has failed in the authentication.

(64) The PC controller 11 determines a result of the authentication (step SB14). When failing in the authentication (NO in step SB14), the PC controller 11 ends the application program 122 and ends this processing.

(65) When succeeding in the authentication (YES in step SB14), the PC controller 11 executes a search in the communication network NW to thereby detect the projectors 2 capable of communicating via the communication network NW (step SB15). In step SB15, the PC controller 11 broadcasts a signal for searching for an apparatus to, for example, another apparatus belonging to a network segment to which the PC 1 belongs in the communication network NW. The signal for searching for an apparatus is a signal for requesting the PC 1 to transmit a response including apparatus information.

(66) FIG. 1 shows an example of IPv4 addresses of the projectors 2A, 2B, 2C, 2D, and 2E in the case in which the communication network NW is configured by a LAN. The IPv4 addresses are addresses of a class C. An address of a network section is “192.168.1”. In the example shown in FIG. 1, the PC controller 11 broadcasts a signal in step SB15 such that pieces of equipment having IP addresses with a common network section can receive the signal. When the communication network NW is configured by Wi-Fi, a network segment is a network designated by one SSID (Service Set Identifier). In this case, the PC controller 11 broadcasts a signal in step SB15 such that pieces of equipment belonging to a network having the same SSID as an SSID of the PC 1 can receive the signal.

(67) In step SB15, the PC controller 11 specifies pieces of equipment that have transmitted responses to the signal transmitted by the PC 1 and detects projectors 2 in the pieces of equipment. The PC controller 11 acquires the apparatus information 223 of the detected projectors 2 from the responses transmitted by the projectors 2 (step SB16).

(68) The PC controller 11 selects one or a plurality of projectors 2 set as processing targets out of the projectors 2 detected in step SB15 (step SB17). In this embodiment, the PC controller 11 selects one projector 2.

(69) The PC controller 11 transmits an authentication request including the PC authentication information 123 to the projector 2 set as the processing target (step SB18). The projector 2 executes the processing in steps SA13 to SA16 in FIG. 4 in response to the authentication request of the PC 1.

(70) The PC controller 11 determines whether a response indicating authentication success is received from the projector 2 (step SA19). When the response indicating the authentication success is not received from the projector 2 within a predetermined time after the authentication request is transmitted to the projector 2 (NO in step SA19), the PC controller 11 shifts to step SB22 explained below.

(71) When the response indicating the authentication success is received from the projector 2 (YES in step SB19), the PC controller 11 executes connection processing (step SB20). The connection processing is processing corresponding to step SA17 in FIG. 4 and includes processing in which the PC 1 requests, with the function of the application program 122, the projector 2 to be connected and establishes communication between the PC 1 and the projector 2. The connection processing includes processing in which the PC 1 brings the projector 2 into a controllable state with the function of the application program 122 executed by the PC 1.

(72) Thereafter, the PC controller 11 displays, on the display 14, display apparatus information including the apparatus information 223 of the projector 2 for which the connection processing is performed (step SB21) and shifts to step SB22.

(73) In step SB22, the PC controller 11 determines whether the processing for all the projectors 2 detected in step SB15 has been completed (step SB22). When steps SB17 to SB19 have been executed for all the projectors 2 detected in step SB15 (YES in step SB22), the PC controller 11 ends this processing. When there is the projector 2 not selected as the processing target among the projectors 2 detected in step SB15 (NO in step SB22), the PC controller 11 returns to step SB17.

(74) FIG. 6 is a diagram showing an example of a screen displayed by the PC 1 and shows an example of a state in which the display apparatus information is displayed in step SB21.

(75) An apparatus information screen 140 is a screen displayed on the display 14 by the control of the PC controller 11 and includes an icon 141 and apparatus information 142. The icon 141 is an image indicating that the projector 2 is detected and indicates the projector 2 to which the PC controller 11 have connected in step SB20 in FIG. 5. For example, when the PC controller 11 connects to three projectors 2 by the processing in FIG. 5, three icons 141 are displayed on the apparatus information screen 140.

(76) The apparatus information 142 is information included in the PC authentication information 123 acquired from the projector 2 by the PC controller 11. For example, the apparatus information

142 is a name of the projector **2**. The apparatus information **142** is displayed in association with the icon **141**. The apparatus information **142** may include a network address of the projector **2** and other information.

(77) The user can visually check, with the apparatus information screen **140**, the number of projectors **2** to which the PC **1** have connected and names and the like of the projectors **2**.

(78) 1-6. Effects and the Like

(79) As explained above, the control method for the information processing apparatus of the present disclosure includes the PC **1** receiving an input of first authentication information and performing authentication based on the PC authentication information **123**, which is the first authentication information, according to the application program **122**, which is a program for controlling a first display apparatus. The control method includes, when the authentication based on the first authentication information is successful, the PC **1** transmitting a connection request including the first authentication information to the first display apparatus via the communication network NW. The control method includes, when authentication by the first display apparatus is successful, the PC **1** connecting to the first display apparatus according to the application program **122**. The first display apparatus is anyone of the projectors **2A**, **2B**, **2C**, **2D**, and **2E**.

(80) With this method, the PC **1** performs authentication processing by the application program **122** based on the authentication information received by the PC **1**. When succeeding in authentication by the application program **122**, the PC **1** connects to the projector **2** based on the authentication information. Accordingly, the user can connect, by inputting authentication information of the application program **122**, the PC **1** and the projector **2** for which authentication is necessary. Therefore, it is possible to, without omitting the authentication concerning the connection of the PC **1** and the projector **2**, reduce a burden on the user concerning the authentication.

(81) In the control method for the information processing apparatus of the present disclosure, the PC **1** controls a second display apparatus according to the application program **122**. The control method may include, when the authentication based on the first authentication information is successful, the PC **1** transmitting a connection request including the first authentication information to the second display apparatus via the communication network NW. The control method may include, when authentication by the second display apparatus is successful, the PC **1** connecting to the second display apparatus according to the application program **122**. The second display apparatus is the projector **2** that is not the first display apparatus among the projectors **2A**, **2B**, **2C**, **2D**, and **2E**. For example, when the first display apparatus is the projector **2A**, the second display apparatus is any one of the projectors **2B**, **2C**, **2D**, and **2E**.

(82) With this method, the PC **1** performs the authentication processing by the application program **122** based on the authentication information received by the PC **1** and, when succeeding in the authentication by the application program **122**, connecting to the plurality of projectors **2**. Accordingly, the user can connect the PC **1** to the plurality of projectors **2** by inputting the authentication information authenticated by the application program **122**. Therefore, it is possible further reduce the burden on the user concerning the authentication.

(83) The application program **122** of the present disclosure is a program for controlling the projector **2**, the application program **122** causing the PC **1** to execute processing including receiving an input of authentication information and performing authentication based on the authentication information. The application program **122** causes the PC **1** to execute processing including, when the authentication based on the authentication information is successful, transmitting a connection request including the authentication information to a display apparatus via a communication network. The application program **122** causes the PC **1** to execute processing including, when authentication by the display apparatus is successful, connecting to the first display apparatus according to the application program **122**.

(84) With this program, the PC **1** performs authentication processing by the application program **122** based on the authentication information received by the PC **1** and, when succeeding in the

authentication by the application program **122**, connecting to the projector **2**. Accordingly, the user can connect the PC **1** to the projector **2** by inputting the authentication information authenticated by the application program **122**. Therefore, it is possible to reduce, without omitting authentication concerning use of the application program **122** and authentication concerning connection of the PC **1** and the projector **2**, a burden on the user concerning the authentication.

2. Second Embodiment

(85) FIG. **7** is a diagram showing a configuration of a PC **1A** in a second embodiment. FIG. **8** is a flowchart showing an operation of the PC **1A** in the second embodiment. The second embodiment is explained with reference to the figures. In the configuration of the PC **1A** shown in FIG. **7**, components common to the PC **1** explained in the first embodiment are denoted by the same reference numerals and signs and explanation of the components is omitted. Kinds of processing common to the operation of the PC **1** explained in the first embodiment in the operation shown in FIG. **8** are denoted by the same step numbers and explanation of the kinds of processing is omitted.

(86) The PC **1A** is an information processing apparatus provided instead of the PC **1** in the display system **100** shown in FIG. **1**. The second embodiment is an example in which at least a part of the projectors **2A**, **2B**, **2C**, **2D**, and **2E** connected to the PC **1A** has the authentication information **224** different from the authentication information **224** of the other projectors **2**. A configuration and an operation of the respective projectors **2** are the same as the configuration and the operation explained with reference to FIG. **4**. That is, as in the first embodiment, each of the plurality of projectors **2** executes the authentication processing based on the authentication information **224** stored in the PJ storage **220**.

(87) As shown in FIG. **7**, in the second embodiment, the PC **1A** stores connection authentication information **124** in the PC storage **120**. The connection authentication information **124** includes apparatus information of the projector **2** and authentication information transmitted to the projector **2** when the PC **1A** connects to the projector **2** in association with each other. The apparatus information of the projector **2** is, for example, the apparatus information **223** acquired from the projector **2** by the PC **1A**.

(88) The number of pieces of connection authentication information **124** stored by the PC storage **120** is not limited. The PC **1A** can store, in the PC storage **120**, the connection authentication information **124** corresponding to the number of projectors **2** to which the PC **1A** connects. In other words, the PC **1A** stores, in the PC storage **120**, the connection authentication information **124** corresponding to the respective projectors **2** included in the display system **100**.

(89) In the operation of the PC **1A** shown in FIG. **8**, after selecting a processing target projector **2** in step SB **17**, the PC controller **11** acquires authentication information corresponding to the PC authentication information **123** of the processing target projector **2** (step SB**31**). In step SB**31**, the PC controller **11** acquires, from the connection authentication information **124** stored by the PC storage **120**, authentication information associated with the PC authentication information **123** acquired in step SB**16** from the processing target projector **2**.

(90) The PC controller **11** determines whether authentication information corresponding to the PC authentication information **123** of the processing target projector **2** is present (step SB**32**). That is, the PC controller **11** determines whether authentication information associated with the PC authentication information **123** acquired in step SB**16** from the processing target projector **2** is present in the connection authentication information **124**.

(91) When the authentication information corresponding to the PC authentication information **123** of the processing target projector **2** is present (YES in step SB**32**), the PC controller **11** shifts to step SB**35** explained below.

(92) When the authentication information corresponding to the PC authentication information **123** of the processing target projector **2** is absent (NO in step SB**32**), the PC controller **11** receives an input of authentication information by the PC input unit **15** (step SB**33**). In step SB**33**, the PC controller **11** may display, with the function of the application program **122**, on the display **14**, a

message for requesting the input of the authentication information and an input box.

(93) The PC controller **11** generates the connection authentication information **124** by associating the authentication information received in step SB33 and the PC authentication information **123** of the processing target projector **2** and stores the connection authentication information **124** in the PC storage **120** (step SB34). Thereafter, the PC controller **11** shifts to step SB35.

(94) In step SB35, the PC controller **11** transmits an authentication request including the authentication information to the processing target projector **2** (step SB35). The authentication request transmitted in step SB35 includes the authentication information acquired in step SB31 or the authentication information received in step SB33.

(95) The PC **1A** according to the second embodiment stores, in the PC storage **120**, the connection authentication information **124** including authentication information corresponding to each of the plurality of projectors **2**. Consequently, even when the plurality of projectors **2** included in the display system **100** have pieces of authentication information **224** different from one another, the PC **1A** can connect to the projector **2** with the function of the application program **122**.

(96) In this way, the configuration explained in the second embodiment achieves the same effects as the effects of the configuration explained in the first embodiment.

(97) Further, in a control method for an information processing apparatus according to the second embodiment of the present disclosure, the PC **1A** controls a third display apparatus according to the application program **122**. The control method includes the PC **1A** receiving second authentication information different from the first authentication information and transmitting, via a communication network, a connection request including the second authentication information to the third display apparatus different from the first display apparatus. The control method includes, when succeeding in authentication by the third display apparatus, the PC **1A** connecting to the third display apparatus according to the application program **122**. The second authentication information is authentication information received in step SB33. The third display apparatus is any one of the projectors **2A**, **2B**, **2C**, **2D**, and **2E** included in the display system **100** and, more specifically, is the projector **2** for which it is determined in step SB32 that the authentication information is absent.

(98) With this method, the PC **1A** is capable of connecting to the projector **2** that performs the authentication using the authentication information different from the PC authentication information **123** of the PC **1A**. Accordingly, the PC **1A** can be connected to a larger number of projectors **2** by operation of the user. Therefore, it is possible to reduce a burden on the user in connecting the PC **1A** to the plurality of projectors **2**.

(99) The control method for the information processing apparatus explained above may include, when succeeding in the authentication by the third display apparatus, the PC **1A** storing the second authentication information in association with the third display apparatus.

(100) Consequently, since the PC **1A** stores the received authentication information as the connection authentication information **124** in association with the third display apparatus, when the PC **1A** connects to the third display apparatus again, the PC **1A** does not have to receive an input by the user. Accordingly, it is possible to further reduce the burden on the user concerning the authentication.

3. Third Embodiment

(101) FIG. **9** is a diagram showing a configuration of a PC **1B** in a third embodiment. FIG. **10** is a flowchart showing an operation of the PC **1B** in the third embodiment. The third embodiment is explained with reference to the figures. In FIG. **9**, components common to the PC **1A** explained in the second embodiment are denoted by the same reference numerals and signs and explanation of the components is omitted. In the operation shown in FIG. **10**, kinds of processing common to the operation shown in FIG. **8** are denoted by the same step numbers and explanation of the kinds of processing is omitted.

(102) The PC **1B** is an information processing apparatus provided instead of the PC **1** in the display system **100** shown in FIG. **1**. In the third embodiment, a configuration and an operation of the

respective projectors **2** are the same as the configuration and the operation explained with reference to FIG. **4**. That is, as in the first embodiment, each of the plurality of projectors **2** executes the authentication processing based on the authentication information **224** stored in the PJ storage **220**. (103) As shown in FIG. **9**, in the third embodiment, the PC **1B** stores the connection authentication information **124** in the PC storage **120**. The connection authentication information **124** is the same as the connection authentication information **124** explained in the second embodiment.

(104) PC authentication information **123a** stored in the PC storage **120** by the PC **1B** is, like the PC authentication information **123**, authentication information used for authentication when the PC **1B** starts the application program **122**. The PC authentication information **123a** includes a plurality of pieces of authentication information. Accordingly, when authentication information received by the PC input unit **15** and any one of the pieces of information included in the PC authentication information **123a** satisfy a predetermined condition, authentication by the application program **122** is successful. Therefore, the user can start the application program **122** properly using the plurality of pieces of authentication information.

(105) The PC **1B** stores connection setting information **125** in the PC storage **120**. The connection setting information **125** is information associating the authentication information included in the PC authentication information **123a** and the projectors **2** to which the PC **1B** connects. The projectors **2** to which the PC **1B** connects are, for example, a part or all of the projectors **2A**, **2B**, **2C**, **2D**, and **2E** capable of communicating with the PC **1B** through the communication network **NW**.

(106) In the example shown in FIG. **9**, the connection setting information **125** includes two pieces of authentication information. PJ_01 and PJ_02 are associated with authentication information including ID:0001 as display apparatuses to be connected. When receiving the authentication information including ID:0001 with the PC input unit **15**, the PC controller **11** connects to the projector **2** having a name PJ_01 and the projector **2** having a name PJ_02. The PC controller **11** does not connect to the other projectors **2**.

(107) Similarly, the connection setting information **125** associates PJ_02, PJ_03, and PJ_04 with authentication information including ID:0002 as display apparatuses to be connected. Accordingly, when receiving the authentication information including ID:0002 with the PC input unit **15**, the PC controller **11** connects to the projector **2** having a name PJ_02, the projector **2** having a name PJ_03, and the projector **2** having a name PJ_04. The PC controller **11** does not connect to a display apparatus different from the projectors **2** set in the connection setting information **125**.

(108) In this way, the PC **1B** can execute the authentication by the application program **122** with the plurality of pieces of authentication information. The PC **1B** connects to, with the function of the application program **122**, only a display apparatus corresponding to authentication information received in the authentication by the application program **122**. Therefore, the user can designate, by properly using authentication information used for the authentication by the application program **122**, the projector **2** to which the PC **1B** connects.

(109) At least a part of the plurality of pieces of authentication information included in the connection setting information **125** only has to be different. For example, the same password may be set in association with different IDs.

(110) In the operation of the PC **1B** shown in FIG. **10**, when succeeding in the authentication processing by the application program **122** (YES in step SB14), the PC controller **11** specifies a display apparatus associated with authentication information used for the authentication processing (step SB41). In step SB41, the PC controller **11** refers to the connection setting information **125**.

(111) Thereafter, the PC controller **11** limits, based on the connection setting information **125**, the projectors **2** detected in step SB15 (step SB42). In step SB42, the PC controller **11** sets, as an apparatus to which, among the projectors **2** detected in step SB15, the projector **2** specified in step SB41 is connected. That is, in step SB42, the PC controller **11** excludes, from targets of the following processing, apparatuses different from the projector **2** specified in step SB41 among the

projectors 2 detected in step SB15.

(112) The PC 1B in the third embodiment is applied, for example, when a use form for selecting and using a part of the projectors 2A, 2B, 2C, 2D, and 2E is effective.

(113) For example, it is assumed that the projector 2A and the projector 2B are disposed to be vertically stacked and the projector 2A and the projector 2B project images onto the same projection surface to be stacked. That is, it is possible to perform stack projection by the projector 2A and the projector 2B. Further, in this example, the projectors 2B, 2C, and 2D are disposed side by side in the horizontal direction or the vertical direction and can perform tiling projection.

Specifically, a projection image of the projector 2B, a projection image of the projector 2C and a projection image of the projector 2D are connected to project one large projection image.

(114) When causing the projector 2A and the projector 2B to execute the stack projection, the PC 1B performs control for causing the projector 2A and the projector 2B to project the same image. In this case, the PC 1B performs, for example, control for causing the projector 2A and the projector 2B to select the same image source and control for causing the projector 2A and the projector 2B to perform geometric correction to match the same projection surface. The control of the PC 1B for causing the projector 2A and the projector 2B to perform the stack projection corresponds to an example of a first control mode.

(115) When causing the projectors 2B, 2C, and 2D to execute the tiling projection, the PC 1B performs control for causing the projectors 2B, 2C, and 2D to perform the tiling projection. The PC 1B performs, for example, control for causing the projectors 2B, 2C, and 2D to execute edge blending processing and control for causing the projectors 2B, 2C, and 2D to execute correction for uniformizing color tones and the like of projection images of the projectors 2B, 2C, and 2D. The control of the PC 1B for causing the projectors 2B, 2C, and 2D to perform the tiling projection corresponds to an example of a second control mode.

(116) In this way, the PC 1B is capable of selecting and executing one of the first control mode for causing the projector 2B to execute the stack projection and the second control mode for causing the projector 2B to execute the tiling projection.

(117) When desiring to cause the projector 2A and the projector 2B to execute the stack projection, the user inputs the authentication information including ID:0001 and performs the authentication by the application program 122. The authentication information corresponds to an example of fourth authentication information. In this case, the PC 1B connects to, according to the connection setting information 125, only the projector 2A and the projector 2B associated with the authentication information including ID:0001. When the authentication information including ID:0001 is input and authentication is executed based on the authentication information, the PC 1B selects the first control mode. The PC 1B executes, with the function of the application program 122, control for causing the projector 2A and the projector 2B to perform the stack projection. That is, the PC 1B controls the projectors 2A and 2B in the first control mode.

(118) When desiring to cause the projectors 2B, 2C, and 2D to execute the tiling projection, the user inputs the authentication information including ID:0002 and performs the authentication by the application program 122. The authentication information corresponds to an example of fifth authentication information. In this case, the PC 1B connects to, according to the connection setting information 125, only the projectors 2B, 2C, and 2D associated with the authentication information including ID:0002. When the authentication information including ID:0002 is input and authentication is executed based on the authentication information, the PC 1B selects the second control mode. The PC 1B executes, with the function of the application program 122, control for causing the projectors 2B, 2C, and 2D to perform the tiling projection. That is, the PC 1B controls the projectors 2B, 2C, and 2D in the second control mode.

(119) With the PC 1B, the user is capable of selecting, by properly using the authentication information, a display apparatus or a combination of display apparatuses to which the PC 1B connects. Accordingly, it is possible to reduce work concerning selection of the projector 2, further

reduce the burden on the user, and achieve improvement of convenience.

(120) In the configuration explained above, the PC 1B may set the operation of the projector 2 according to the authentication information received by the PC input unit 15. In the example explained above, when receiving the authentication information including ID: 0001 with the PC input unit 15, after connecting to the projectors 2A and 2B, the PC 1B may transmit setting information for the stack projection to the projectors 2A and 2B. When receiving the authentication information including ID:0002 with the PC input unit 15, after connecting to the projectors 2B, 2C, and 2D, the PC 1B may transmit setting information for the tiling projection to the projectors 2B, 2C, and 2D. In this example, the user can optimize setting concerning the operation of the projector 2 by properly using the authentication information.

(121) The configuration explained in the third embodiment achieves the same effects as the effects of the configurations explained in the first embodiment and the second embodiment.

(122) Further, in the control method for the information processing apparatus according to the third embodiment of the present disclosure, the PC 1B controls a fourth display apparatus according to the application program 122. The control method includes the PC 1B storing third authentication information different from the first authentication information and the second authentication information in association with the fourth display apparatus. The control method includes the PC 1B receiving fourth authentication information or fifth authentication information different from the fourth authentication information. The control method includes the PC 1B transmitting a connection request including the third authentication information to the fourth display apparatus via the communication network NW according to the reception of the fourth authentication information or the fifth authentication information. The control method includes, when succeeding in authentication by the fourth display apparatus, the PC 1B connecting to the fourth display apparatus according to the application program 122. The control method includes the PC 1B controlling the fourth display apparatus in the first control mode according to the application program 122 when receiving the fourth authentication information and controlling the fourth display apparatus in the second control mode according to the application program 122 when receiving the fifth authentication information. The fourth display apparatus is any one of the projectors 2A, 2B, 2C, 2D, and 2E and is the projector 2B in the example explained above. The third authentication information is authentication information included in the connection authentication information 124 in association with the fourth display apparatus. The fourth authentication information and the fifth authentication information are, for example, authentication information authenticated based on the PC authentication information 123a and can be considered authentication information included in the connection setting information 125.

(123) With this method, the user can properly use a plurality of pieces of authentication information as authentication information in causing the application program 122 to operate in the PC 1B. The user can designate the projector 2 to which the PC 1B connects and cause the PC 1B to execute the connection by properly using the authentication information. Accordingly, it is possible to reduce work concerning selection of the projector 2, further reduce the burden on the user, and achieve improvement of convenience.

4. Other Embodiments

(124) The first and second embodiments explained above are preferred modes of implementation of the present disclosure. However, the present disclosure is not limited to the embodiments. Various modified implementations are possible without departing from the gist of the present disclosure.

(125) For example, in the embodiments explained above, the display system 100 adopting the projector 2 as an example of the display apparatus is explained. However, the display apparatus to which the present disclosure is applied is not limited to the projector 2. For example, the display apparatus may be a liquid crystal display that displays an image on a liquid crystal display panel or may be a display apparatus that displays an image on a plasma display panel or an organic EL (Electro Luminescence) panel. In this case, the liquid crystal display panel, the plasma display

panel, or the organic EL panel corresponds to an example of a display.

(126) The configurations of the PC controller **11** and the PJ controller **21** are not limited. The PC controller **11** and the PJ controller **21** may be realized by a plurality of processors or a plurality of semiconductor devices.

(127) The functional units of the projector **2** shown in FIG. **2** indicate functional components. Specific implementation forms of the functional units are not particularly limited. Similarly, the functional units of the PC **1**, PC **1A**, and PC **1B** shown in FIGS. **3**, **7**, and **9** indicate functional components. Specific implementation forms of the functional units are not particularly limited. Hardware individually corresponding to the illustrated functional units does not need to be implemented. It is naturally possible to adopt a configuration in which one processor executes a program to realize functions of a plurality of functional units. A part of functions realized by software in the embodiments may be realized by hardware. Apart of functions realized by hardware in the embodiments may be realized by software.

(128) The processing units of the flowcharts shown in FIGS. **4**, **5**, **8**, and **10** are divided according to main processing contents in order to facilitate understanding of the processing of the PC controller **11** and the PJ controller **21**. The present disclosure is not limited by a way of division and names of the processing units. These kinds of processing can be divided into, according to processing contents, a larger number of processing units and can be divided such that one processing unit includes a larger number of kinds of processing. The processing order of the flowcharts explained above is not limited to the illustrated example.

(129) The OS **121** and the application program **122** to be executed by the PC controller **11** and the control program **221** to be executed by the PJ controller **21** can also be recorded in, for example, a recording medium to be readable by the PCs **1**, **1A**, and **1B** and the projector **2**. As the recording medium, a magnetic or optical recording medium or a semiconductor memory device can be used. Specific examples of the recording medium include portable or stationary recording media such as a flexible disk, a CD-ROM (Compact Disk Read Only Memory), a DVD (Digital Versatile Disc), a Blu-ray (registered trademark) Disc, a magneto-optical disk a flash memory, and a card-type recording medium. The control method explained above can also be realized by storing these programs in a server apparatus or the like and downloading a control program from the server apparatus.

Claims

1. A control method for an information processing apparatus comprising: receiving an input of first authentication information; performing authentication based on the first authentication information according to a program for controlling a first display apparatus; when the authentication based on the first authentication information is successful, transmitting a connection request including the first authentication information to the first display apparatus via a communication network; when the authentication by the first display apparatus is successful, connecting to the first display apparatus according to the program; storing second authentication information different from the first authentication information in association with a second display apparatus controlled by the program; receiving third authentication information or fourth authentication information different from the third authentication information; transmitting a connection request including the second authentication information to the second display apparatus via the communication network according to the reception of the third authentication information or the fourth authentication information; when authentication by the second display apparatus is successful, connecting to the second display apparatus according to the program; when receiving the third authentication information, controlling the second display apparatus in a first control mode according to the program; and when receiving the fourth authentication information, controlling the second display apparatus in a second control mode according to the program.

2. A non-transitory computer-readable storage medium storing a program for controlling a display apparatus, the program causing an information processing apparatus to execute processing comprising: receiving an input of authentication information; performing the authentication based on the authentication information; when the authentication based on the authentication information is successful, transmitting a connection request including the authentication information to the display apparatus via a communication network; when the authentication by the display apparatus is successful, connecting to the display apparatus; storing second authentication information different from the first authentication information in association with a second display apparatus controlled by the program; receiving third authentication information or fourth authentication information different from the third authentication information; transmitting a connection request including the second authentication information to the second display apparatus via the communication network according to the reception of the third authentication information or the fourth authentication information; when authentication by the second display apparatus is successful, connecting to the second display apparatus according to the program; when receiving the third authentication information, controlling the second display apparatus in a first control mode according to the program; and when receiving the fourth authentication information, controlling the second display apparatus in a second control mode according to the program.
