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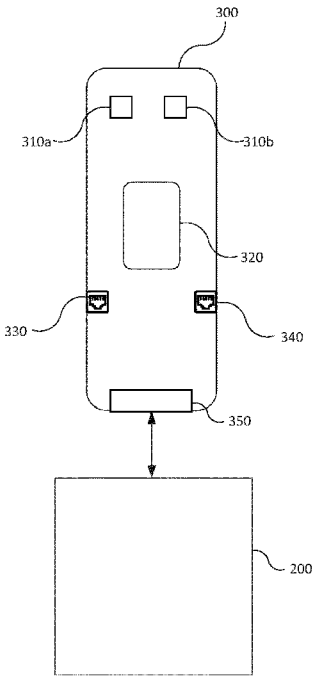

Figure 2

(57) Abstract: A controller (300) for controlling an electronic device (200) is provided. The controller (300) comprises a first data port (330), a second data port (340), and a processor (320). The second data port (340) is connectable to the first data port (330) using a wired connection for sending data from the first port (330) to the second port (340). The processor (320) is configured to: send a trigger via the first data port (330); and in response to detecting receipt of said trigger via the second data port (340), cause a predetermined procedure to be performed by the electronic device (200).

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CONTROLLER FOR AN ELECTRONIC DEVICE AND METHOD FOR OPERATING A CONTROLLER

Technical Field

The present disclosure relates to a controller for an electronic device and method for operating a controller for an electronic device.

Background

Testing of electronic devices is important to ensure proper operation, and to check for issues. For example, it may be desirable to test a display device to check for broken pixels in the display, or may wish to test an audio device to check for sound quality issues.

Figure 1 shows schematically a known controller 10 for an electronic device (not shown). The controller 10 comprises power terminals 11a, 11b, a processor 12, an input data port 13, an output data port 14, an interface 15, and a test button 16. The data ports 13, 14 allow the controller 10 to receive and send data, respectively (or, the ports 13, 14 may be dual input/output ports capable of both receiving and sending data). The controller 10 is operatively coupled to the electronic device via its interface 15. In operation, the processor 12 controls the electronic device via the interface 15 in accordance with data received via the input port 13.

The test button 16 is for testing whether the electronic device and/or controller 10 are functioning correctly. When the test button 16 is pressed, the processor 12 causes a predetermined procedure to be performed by the electronic device. When the electronic device is a media device such as a display device, for example, the processor 12 may send a predetermined image (a “test image” or “test pattern”) to be displayed by the display device when the test button 16 is pressed. The predetermined image may be, for example, a full white image, allowing a user to visually identify any broken display elements in the display device.

Summary

According to a first aspect disclosed herein, there is provided a controller for controlling an electronic device, the controller comprising: a first data port; a second data port which is connectable to the first data port using a wired connection for sending data from the first port to the second port; and a processor configured to: send a trigger via the first data port; and in response to detecting receipt of said trigger via the second data port, cause a predetermined procedure to be performed by the electronic device.

The present disclosure proposes an additional use for the first and second port of the controller: the triggering of a predetermined procedure, such as for example a test procedure or debug procedure, or to restart the electronic device. In an example, a user can connect the first and second data ports, using for example a wired connection provided by one or more cables, allowing a trigger to start the procedure to be sent from one data port to the other.

The predetermined procedure to be performed by the electronic device may be one or more procedures, depending on for example the nature of the electronic device or the current status of the electronic device.

In an example, the processor is configured to cause a test procedure to be performed by the electronic device in response to detecting receipt of said trigger via the second data port. That is, the test procedure may be a test procedure to be performed by the electronic device.

In an example, the processor is configured to cause a test pattern to be displayed on a display screen of the electronic device in response to detecting receipt of said trigger via the second data port. That is, the procedure may comprise displaying a test pattern on a display screen of the electronic device. The test pattern may be a still or video image.

In an example, the processor is configured to cause a test sound to be output by a speaker of the electronic device in response to detecting receipt of said trigger via

the second data port. That is, the procedure may comprise outputting a test sound by a speaker of the electronic device.

In an example, the processor is configured to cause a debug process to be performed by the electronic device in response to detecting receipt of said trigger via the second data port. That is, the procedure may comprise the electronic device carrying out a debug process. An example of a debug process is the output (e.g. display or playback via a loudspeaker) of system information (e.g. voltage levels, temperature levels, memory status, software firmware version numbers, etc.).

In an example, the processor is configured to cause the electronic device to restart with a default setting in response to detecting receipt of said trigger via the second data port. That is, the procedure may comprise restarting the electronic device with a default setting. The default setting could be a factory setting.

In an example, the processor is configured to send said trigger periodically.

In an example, the processor is configured to send said trigger in response to determining that there is a fault with the electronic device. For example, the electronic device may have a fault if it has crashed.

In an example, the processor is configured to send said trigger in response to determining that there is no data being received at either the first data port or the second data port. In an example, the processor is configured to send said trigger in response to determining that there is no image or video data being received at either the first data port or the second data port.

In an example, wherein the processor is configured to send said trigger only if it is determined that no data is being received at either port.

The processor may send said trigger before an auxiliary component is connected to the media device. For example, the processor may send said trigger during a manufacturing stage of the media device. This allows a manufacturer to

connect the first and second ports in order to test the media device before it is shipped. In particular, this can be useful before software (firmware) for auxiliary components is installed.

The electronic device may be, in examples, one of: an LED or other light wall cabinet, a sending card for a display, a server, a video processor, a desktop computer, a gaming console, a modem, a set up box, a laptop, a television, a DS device, or a sound system (music box).

In an example, the first and second port use the same transmission protocol and the trigger is sent using said protocol. An advantage of this is that it simplifies the connection. There may be no need for an "external regulator" to switch protocols ("data transmission protocols").

In an example, the first and second ports use different protocols. In such cases, the first data port and second data port may be connected via an "external regulator" for converting between the protocols.

The first and second ports may be selected from: an Ethernet port, a USB port, an I2C port, an SPI port, or an HDMI port.

In an example, the processor is configured to determine if there is a fault with the electronic device; to send said trigger with a first frequency if there is no fault with the electronic device; and to send said trigger with a second frequency if there is a fault with the electronic device. The second frequency may be higher than the first.

In an example, the processor is configured to send said trigger via the first data port after causing the predetermined procedure to be performed by the electronic device, and in response to not detecting receipt of said trigger via the second data port, cause the electronic device to stop performing the predetermined procedure.

According to a second aspect disclosed herein, there is provided a method performed by a controller of an electronic device, said controller having a first data

port and a second data port which is connectable to the first data port using a wired connection for sending data from the first port to the second port, the method comprising: sending a trigger via the first data port of the controller; and in response to detecting receipt of said trigger via the second data port of the controller, causing a predetermined procedure to be sent to performed by the electronic device.

Brief Description of the Drawings

To assist understanding of the present disclosure and to show how embodiments may be put into effect, reference is made by way of example to the accompanying drawings in which:

Figure 1 shows schematically a known controller for an electronic device;

Figure 2 shows schematically an example of a controller for an electronic device in accordance with the present disclosure;

Figure 3 shows schematically an example comprising two controllers inter-connected;

Figure 4 shows schematically an LED wall cabinet;

Figure 5 shows schematically an example of a controller installed on the rear of an LED wall cabinet;

Figure 6 shows schematically a first example of connection of ports of a controller;

Figure 7 shows schematically a second example of connection of ports of a controller; and

Figure 8 shows schematically a flow chart of an example method in accordance with the present disclosure.

Detailed Description

The present disclosure relates to a controller for an electronic device. The controller has a first data port and a second data port. An example of an electronic device which may be controlled by the controller is a display module of a "video wall". A video wall is a type of display device in which a plurality of individual display modules are tiled together and cooperate to display an image across the multiple display modules. Another example of an electronic device which may be controller by the controller is a loudspeaker forming part of a surround sound system.

The first and second data ports of such controllers may be used to receive data at and/or send data from the controller. In use in some applications, the data ports of such controllers may be used to connect the controller to one or more other similar controllers. This is useful for many types of electronic device in which coordination between multiple controllers is required, including for example in video walls.

The present disclosure proposes an additional use for the first and second data ports of the controller: causing a predetermined procedure to be performed by the electronic device. This is achieved by connecting the data ports and sending a trigger for the procedure from one port to the other.

Predetermined procedures which may be performed by the electronic device depend on the type of electronic device. For example: if the electronic device comprises a display, the predetermined procedure may be the display of a test image (allowing a user to identify faults with the display); or if the electronic device comprises a loudspeaker, the predetermined procedure may be the output of a test sound (allowing a user to identify faults with the loudspeaker). Other examples of predetermined procedures include a debug procedure, or a restart of the electronic device.

Causing the predetermined procedure to be carried out in this manner means that a user can cause the predetermined procedure to be performed by simply connecting the first and second port. This means that a button for this purpose (e.g.

test button 160 in Figure 1) is not required, and therefore the controller can be made smaller, simpler, and cheaper, while still achieving the same functionality. In other words, the user can easily test the electronic device by simply connecting the controller to itself.

In operation, the controller determines when the first and second port have been connected by sending a "trigger" (a predetermined sequence of bits or symbols) via one data port, and determining whether the trigger is received via the other data port. If the trigger is received via the other data port, this means that the data ports are connected (either directly or indirectly), and so the controller causes the predetermined procedure to be performed by the electronic device.

Figure 2 shows schematically a controller 300 for an electronic device 200 in accordance with examples described herein. The electronic device 200 may comprise, for example, one or more display screens, loudspeakers, haptic feedback devices, light sources, etc. A specific example of an electronic device 200 is an LED cabinet of an LED wall, such as shown in Figure 4 described later below.

The controller 300 comprises power terminals 310a, 310b, a processor 320, a first data port 330, a second data port 340, and an interface 350. The processor 320 is operatively coupled to the first data port 330, the second data port 340, and the interface 350. The processor 320 may be, for example, a control core; including, processors, FPGA (field programmable gate array), etc. including one or more power systems (LDO, smps), peripheral devices etc. such as memory, RAM, etc.

The power terminals 310a, 310b are for connecting the controller 300 to a power source, as is known in the art (e.g. the power source may be an external power source such as a main power supply, or may be an internal power source such as an internal battery of the controller 300).

The first data port 330 and second data port 340 allow the controller 300 to receive and send data. In some examples, one data port 330, 340 may be used as an input port (for receiving data) and the other data port 330, 340 as an output port (for

sending data). In other examples, one or both of the ports 330, 340 could be capable of both sending and receiving data. The data ports 330, 340 may in general be any type of port, using any protocol. Examples of data ports include: Ethernet ports, USB ports, I2C ports, SPI ports, or HDMI ports. The data ports 330, 340 may or may not be of the same type. The ports may be provided with one or more transformers between the port and the processor 320, as known in the art, for transforming a signal voltage.

The controller 300 is operatively coupled to the electronic device 200 via its interface 350. In operation, the processor 320 controls the electronic device 200 via the interface 350 in accordance with data received via one or other of the data ports 330, 340.

In some applications, the data ports 330, 340 are used to allow a plurality of such controllers 300 to be connected to one another, each controller 300 being for controlling a respective electronic device 200. The interconnection of multiple controllers 300 allows the controllers 300 to coordinate control of their respective electronic devices 200. In operation, the processor 320 of each controller 300 may receive data via the input port 330 and both a) control the electronic device 200 in accordance with the data; and b) forward the data via the second port 340 to the next controller 300. For example, when the electronic devices 200 comprises a display module, multiple display modules may be tiled together to form one substantially contiguous screen, and the controllers 300 may coordinate control of each of the individual display modules. In any event, there may be a dedicated external "master" controller connected to the controllers 300 for coordination of the controller 300. Alternatively, one of the controllers 300 may operate as the master controller.

An example of multiple inter-connected controllers 300 is shown in Figure 3, in which a first controller 300a and a second controller 300b are connected as part of a series or "daisy-chain" topology. The first controller 300a is associated with a first electronic device 200a and the second controller 300b is associated with a second electronic device 200b, in the manner described above. It is appreciated that the arrangement shown in Figure 3 may be only a small part of a larger series of controllers 300 and electronic devices 200.

In the example of Figure 3, the second port 340a of the first controller 300a is connected to the first port 330b of the second controller 300b via a direct wired connection 400 (e.g. a cable). Further controllers 300 if present may be similarly connected, with the second port 340 of one controller 300 being connected via a wired connection to the first port 330 of the next controller 300 in sequence. It is appreciated that this configuration is just an example, and that the connection of multiple controllers 300 may be provided with any suitable topology that allows data to be sent between the controllers 300.

In Figure 3, the inter-controller connections are illustrated as direct wired connections 400 between the ports 330, 340. However, it is appreciated that such a connection may be wired or wireless, and may be direct or indirect (e.g. via one or more other devices, such as an external converter for converting between protocols, and/or via one or more other ports such as external ports 430, 440 described below).

In accordance with examples described herein, the data ports 330, 340 (of a same controller 300) may also be connected to one another, such that data sent via the second port 340 is received at the first port 330 or vice versa. In other words, the controller 300 may be connected to itself via the data ports 330, 340. The intra-connection of a controller 300 may be provided by a direct connection between the ports 330, 340 of that controller 300 (e.g. using a cable connection) or an indirect connection between the ports 330, 340 of that controller 300 (e.g. via one or more other devices, such as an external converter for converting between protocols, and/or via one or more other ports such as external ports 430, 440 described below).

If the data ports 330, 340 are of the same type (use the same protocol), then the data ports 330, 340 may be connected directly to one another. If the data ports 330, 340 are not of the same type (use a different protocol), then an external converter (external regulator) may be provided. For example, the first data port 330 may use a first protocol and the second data port 340 may use a second protocol different from the first protocol. Data sent via the second port 340 according to a second protocol

may be converted to the first protocol by the external converter, and then forwarded to the first port 330, and vice versa.

In operation, the processor 320 is configured to send a trigger from one of the data ports 330, 340 and determine whether the trigger is received at the other data port 330, 340.

The trigger may be any suitable data which can be detected by the processor 320 if received. In an example, the processor 320 of each controller 300 has its own unique trigger. This allows the processor 320 to distinguish its own trigger from those of other controllers to which it may be connected. The trigger may be, for example, a predetermined sequence of bits or symbols, an identifier of the controller 300, etc. As another example, the trigger may be a random number generated by the processor 320 each time a trigger is to be sent, e.g. the trigger may be a random data package (e.g. ten random bits).

If the trigger is received via the other data port 330, 340, then this means that the first data port 330 and second data port 340 are connected, and the processor 320 proceeds to cause the electronic device to perform the predetermined procedure.

Various examples of predetermined procedures are envisaged. The specific type of predetermined procedure or procedures that the processor 320 may cause the electronic device 200 to perform depends on the type of electronic device 200. For example, the processor 320 may cause the electronic device to:

- perform a test procedure;
- perform a debug procedure; and
- perform a restart process.

Examples of test procedures include the display of a predetermined test image by one or more display screens of the electronic device 200, and the output of a predetermined test sound by one or more loudspeakers of the electronic device 200. Other test procedures are possible. Again, it is noted that this means that a button for

this purpose (e.g. test button 160 in Figure 1) is not required on the controller 300, and therefore the controller 300 can be made smaller, simpler, and cheaper, while still achieving the same functionality. The user can easily arrange testing of the display screens of the electronic device 200, the audio playback, etc. by connecting the data ports 330, 340 of the controller 300 using a cable or the like, and no separate test button to initiate the testing is required.

A predetermined image may be, for example, full red, full green, full blue, full white, etc. The image may be a static or video image. For example, the image may be a video image with a (possibly gradual) change between two or more states, e.g. a repeated transition between full red, full green, full blue.

The predetermined image and/or sound may be stored inside a memory of the controller 300 (not shown) accessible by the processor 320. In other examples, the processor 320 may send an instruction to the electronic device 200 to display the predetermined image and/or output the predetermined sound (rather than the image/sound itself). In these cases, the predetermined image and/or sound may be stored inside a memory (not shown) accessible by the electronic device 200.

As another example the processor 320 may cause the electronic device 200 to output system information. Here, "output" includes the display of the system information on a display, the playback of the system information audibly via a loudspeaker, etc. Examples of system information include voltage levels, temperature levels, memory status, software firmware version numbers, etc. This may be used for a number of purposes, including for example as part of a debug procedure.

The processor 320 may be configured to send the trigger based on a number of scenarios. Various examples are given below. Any one or more of these examples may be implemented together.

In a first example, the processor 320 may be configured to send the trigger in response to determining that there is no (image or video) data being received via either port 330, 340. The term "data" here refers to the data which is intended for use by the

electronic device 200. For example, if the electronic device 200 comprises a display screen, such data may be image or video data. In some examples, the processor 320 checks both ports 330, 340 to determine whether data is being received via either port 330, 340. In examples in which one port is an input port and the other port is an output port, the processor 320 may only check the input port.

In a second example, the processor 320 may be configured to send the trigger periodically, i.e. at a certain frequency. For example, the processor 320 may send the trigger once a second, once a minute, etc.

In a third example, the processor 320 may be configured to send the trigger in response to determining that there is a fault with the electronic device 200. For example, the processor 320 may determine that the electronic device 200 has crashed and cause the trigger to be sent in response.

In a fourth example, the processor 320 may be configured to send the trigger in response to determining that the electronic device 200 has restarted.

In a fifth example, the processor 320 may be configured to determine if there is a fault with the electronic device 200, or if the electronic device 200 has restarted; to send said trigger periodically with a first frequency if there is no fault with the electronic device; and to send said trigger periodically with a second frequency if there is a fault with the electronic device. The second frequency may be higher than the first frequency. This means that the triggering of the predetermined procedure will be performed more quickly in the fault state, once the user has connected the the ports 330, 340.

In any of the examples, the processor 320 may be configured to send said trigger only if it is determined that no data is being received at either port. That is, the processor 320 may perform an additional "check" (similar to the first example) to determine whether there is data being received at either port 330, 340, and only proceed to send the trigger if there is no data being received.

In any event, the processor 320 may send said trigger before an auxiliary component is connected to the electronic device 200. For example, the processor 320 may be caused to send said trigger by connecting the first port 330 and second port 340 during a manufacturing stage of the electronic device 200. This allows a manufacturer to test the electronic device 200 at one or more stages during manufacture and before final assembly or installation of all components. In particular, this can be useful for testing components before software (firmware) for auxiliary components is installed.

In an example, the processor 320 may be configured to send another instance of the trigger (i.e. after already having caused the predetermined procedure to begin being performed by the electronic device 200). If the processor 320 then determines that it has not received this second instance of the trigger (e.g. within a certain time period), the processor 320 may then cause the electronic device to stop performing the predetermined procedure. Put differently, the processor 320 may continue to send instances of the trigger (e.g. with a given frequency) even after it has caused the predetermined procedure to begin, and stop the predetermined procedure if the ports 330, 340 become disconnected. Hence, a user can both start and stop the predetermined procedure by simply connecting and disconnecting the ports 330, 340.

As mentioned, an example of an electronic device 200 which may be controlled by the controller 300 is display module of a "video wall". A specific example of a video wall is an LED wall, which is formed of a plurality of individual LED wall "cabinets". An example of an LED wall cabinet 20 is shown schematically in Figure 4. A plurality of such LED wall cabinets 20 may be tiled together to form one substantially contiguous screen. (Whilst reference is made here to the video wall being an LED wall, it will be understood that other light sources and different screen technology may be used, including for example OLEDs or LCD display screens with backlights, etc.)

Each LED wall cabinet 20 comprises a plurality of LED packages 22 for displaying static or video images. An LED package may be, for example, a "pixel" comprising a plurality of sub-pixels. The LED packages 22 may be grouped into a

number of discrete LED modules 21 which in use are located adjacent each other. In the example of Figure 4, the LED wall cabinet 20 comprises four LED modules 21, each comprising a respective number of LED packages 22. It is appreciated that the arrangement shown in Figure 2 is an example only and that, in reality, each LED wall cabinet 20 typically comprises a large number of LED packages 22, which may optionally be grouped into any number of LED modules 21.

Typically, each LED wall cabinet 20 has its own controller for controlling display of images using the LED packages 22. The controllers may be connected together to allow the controllers to coordinate the display of images via the respective LED wall cabinets 20. For example, the plurality of LED wall cabinets 20 may act together as a single display screen, such that a single image (e.g. represented by a single image file) can be displayed across the multiple LED wall cabinets 20.

In some examples, such as illustrated schematically in Figure 5, the controller 300 may be installed inside the display module 200. In this case, the first port 330 and second port 340 of the controller 300 may be inaccessible from the outside of the display module 200. Therefore, a first port 430 and second port 440 may be provided on the outside of the display module 200. These may be referred to as "external" ports 430, 440 to distinguish them from the "internal" ports 330, 340 of the controller 300 itself. The external first port 430 is connected to the internal first port 330 e.g. via a direct wired connection 410 and the external second port 440 is connected to the internal second port 340 e.g. via a direct wired connection 420.

Figure 6 shows an example in which the (internal) first port 330 and second port 340 are connected directly to one another via a wired connection 500. That is, in this example, the first port 330 and second port 340 are connected directly to one another by the wired connection 500. This wired connection 500 can be provided for example by a short cable

Figure 7 shows an alternative example in which the (internal) ports 330, 340 are connected to one another indirectly (i.e. functionally), but via the external ports 430, 440 of the display module 200 instead. Specifically, in this example, the external

first port 430 and external second port 440 are connected directly to one another by a wired connection 501. This wired connection 501 can be provided for example by a short cable. Because the first and second external ports 430, 440 are connected to the first and second internal ports 330, 340, this means that the first internal port 330 and second internal port 340 are also connected to one another. The difference in this example (relative to Figure 6) is that this connection is indirect.

It is appreciated that the arrangements of Figures 6 and 7 are just two examples, and that any arrangement which results in data sent from one port 330, 340 being received at the other port 340, 330 can be used.

Figure 8 shows schematically a flow chart of a method performed by the processor 320 of the controller 300 in accordance with an example described herein. For simplicity, it will be assumed that the electronic device 200 is a display device such as an LED wall cabinet 20. The method starts at S800.

At S801, the processor 320 checks whether image or video data is being received (e.g. via either port 330, 340). If the processor 320 determines that no data is being received, the method proceeds to S802. If not, the method proceeds to S803.

At S802 the processor 320 causes the (e.g. image or video) data received via the first port 330 to be displayed by the LED wall cabinet 20 to which it is connected. That is, the processor 320 may send the image data to the LED wall cabinet 20 via the interface 350 for display by the LED wall cabinet 20.

At S803, the processor 320 sends a trigger via the second port 340.

At S804, the processor 320 determines whether the trigger is received at the first port 330. If so, the method proceeds to S806. If not, the method ends at S805. The method may then repeat e.g. automatically.

At S806, the processor 320 causes the LED wall cabinet 20 to perform a predetermined procedure (e.g. a test procedure or debug procedure). For example, the

processor 320 may send a predetermined test image to the LED wall cabinet 20 for display by the display module 200.

In the example described above, the electronic device 200 to which the controller 300 is connected is an LED wall module 200 and the predetermined procedure was the display of a predetermined image ("test image"). However, as mentioned, this is only an example. The electronic device, in other examples, may be any type of display device, audio device, etc. (or combination thereof). Examples include: a sending card for a display, a server, a video processor, a desktop computer, a gaming console, a modem, or a set up box. The predetermined procedure which the processor 320 causes the electronic device to perform in response to detecting the trigger via the input port 330 depends on the type of electronic device. For example, if the media device is an audio device then the predetermined procedure item may be the output of an audio item (e.g. a predetermined sound or series of sounds). That is, the processor 320 may send a predetermined audio item to the audio device for playback, or the processor 320 may send an instruction to the audio device to playback a predetermined audio item.

As a specific example, the electronic device may be a speaker which is part of a surround sound system. Such a speaker may need to coordinate with other speakers in the surround sound system. As such, the speaker may be provided with a controller having both an input port and output port in the same manner described above, for connecting the controllers of the speakers to one another. In such examples, the controller may perform the same method described above to determine to cause the speaker to perform a predetermined procedure. The predetermined procedure may be, for example, to output, via the speaker, a predetermined sound or sequence of sounds.

It will be understood that the processor or processing system or circuitry referred to herein may in practice be provided by a single chip or integrated circuit or plural chips or integrated circuits, optionally provided as a chipset, an application-specific integrated circuit (ASIC), field-programmable gate array (FPGA), digital signal processor (DSP), graphics processing units (GPUs), etc. The chip or chips may comprise circuitry (as well as possibly firmware) for embodying at least one or more

of a data processor or processors, a digital signal processor or processors, baseband circuitry and radio frequency circuitry, which are configurable so as to operate in accordance with the exemplary embodiments. In this regard, the exemplary embodiments may be implemented at least in part by computer software stored in (non-transitory) memory and executable by the processor, or by hardware, or by a combination of tangibly stored software and hardware (and tangibly stored firmware).

Reference is made herein to data storage for storing data. This may be provided by a single device or by plural devices. Suitable devices include for example a hard disk and non-volatile semiconductor memory (including for example a solid-state drive or SSD).

Although at least some aspects of the embodiments described herein with reference to the drawings comprise computer processes performed in processing systems or processors, the invention also extends to computer programs, particularly computer programs on or in a carrier, adapted for putting the invention into practice. The program may be in the form of non-transitory source code, object code, a code intermediate source and object code such as in partially compiled form, or in any other non-transitory form suitable for use in the implementation of processes according to the invention. The carrier may be any entity or device capable of carrying the program. For example, the carrier may comprise a storage medium, such as a solid-state drive (SSD) or other semiconductor-based RAM; a ROM, for example a CD ROM or a semiconductor ROM; a magnetic recording medium, for example a floppy disk or hard disk; optical memory devices in general; etc.

The examples described herein are to be understood as illustrative examples of embodiments of the invention. Further embodiments and examples are envisaged. Any feature described in relation to any one example or embodiment may be used alone or in combination with other features. In addition, any feature described in relation to any one example or embodiment may also be used in combination with one or more features of any other of the examples or embodiments, or any combination of any other of the examples or embodiments. Furthermore, equivalents and

modifications not described herein may also be employed within the scope of the invention, which is defined in the claims.

CLAIMS

1. A controller for controlling an electronic device, the controller comprising:

a first data port;

a second data port which is connectable to the first data port using a wired connection for sending data from the first port to the second port; and

a processor configured to:

send a trigger via the first data port; and

in response to detecting receipt of said trigger via the second data port, cause a predetermined procedure to be performed by the electronic device.

2. A controller according to claim 1, wherein the processor is configured to cause a test procedure to be performed by the electronic device in response to detecting receipt of said trigger via the second data port.

3. A controller according to claim 1 or claim 2, wherein the processor is configured to cause a test pattern to be displayed on a display screen of the electronic device in response to detecting receipt of said trigger via the second data port.

4. A controller according to any of claims 1 to 3, wherein the processor is configured to cause a test sound to be output by a speaker of the electronic device in response to detecting receipt of said trigger via the second data port.

5. A controller according to any of claims 1 to 4, wherein the processor is configured to cause a debug process to be performed by the electronic device in response to detecting receipt of said trigger via the second data port.

6. A controller according to any of claims 1 to 5, wherein the processor is configured to cause the electronic device to restart with a default setting in response to detecting receipt of said trigger via the second data port.

7. A controller according to any of claims 1 to 6, wherein the processor is configured to send said trigger periodically.

8. A controller according to any of claims 1 to 7, wherein the processor is configured to send said trigger in response to determining that there is a fault with the electronic device.

9. A controller according to any of claims 1 to 8, wherein the processor is configured to send said trigger in response to determining that there is no data being received at either the first data port or the second data port.

10. A controller according to any of claims 1 to 9, wherein the processor is configured to send said trigger only if it is determined that no data is being received at either port.

11. A controller according to any of claims 1 to 10, wherein the first and second port use the same transmission protocol and the trigger is sent using said protocol.

12. A controller according to any of claims 1 to 10, wherein the first and second ports use different protocols.

13. A controller according to any of claims 1 to 12, wherein the processor is configured to determine if there is a fault with the electronic device; to send said trigger with a first frequency if there is no fault with the electronic device; and to send said trigger with a second frequency if there is a fault with the electronic device.

14. A controller according to any of claims 1 to 13, wherein the processor is configured to send said trigger via the first data port after causing the predetermined procedure to be performed by the electronic device, and in response to not detecting receipt of said trigger via the second data port, cause the electronic device to stop performing the predetermined procedure.

15. A method performed by a controller of an electronic device, said controller having a first data port and a second data port which is connectable to the first data

port using a wired connection for sending data from the first port to the second port, the method comprising:

sending a trigger via the first data port of the controller; and

in response to detecting receipt of said trigger via the second data port of the controller, causing a predetermined procedure to be sent to performed by the electronic device.

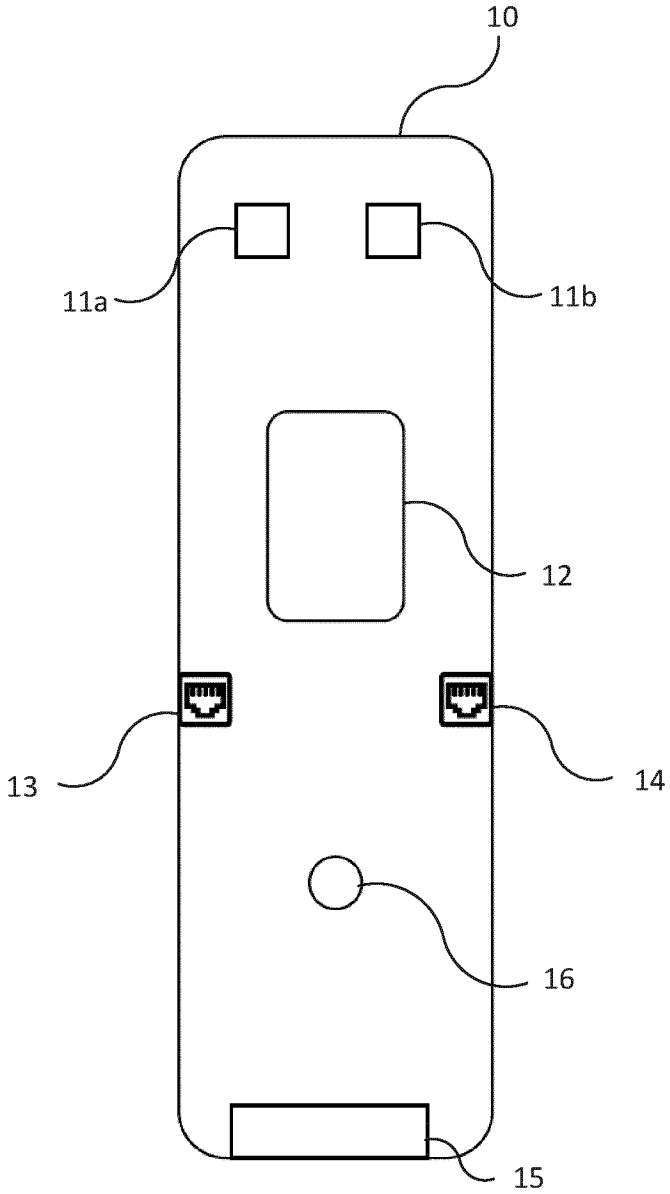

Figure 1
PRIOR ART

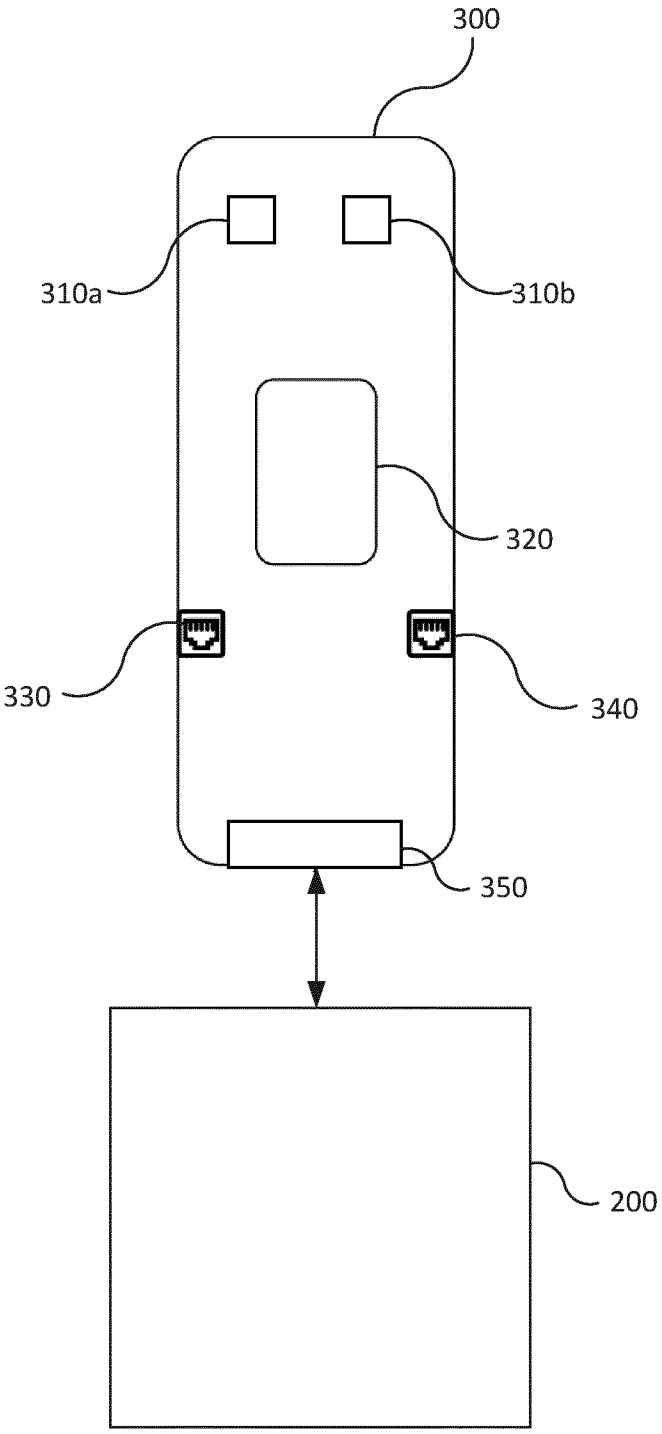

Figure 2

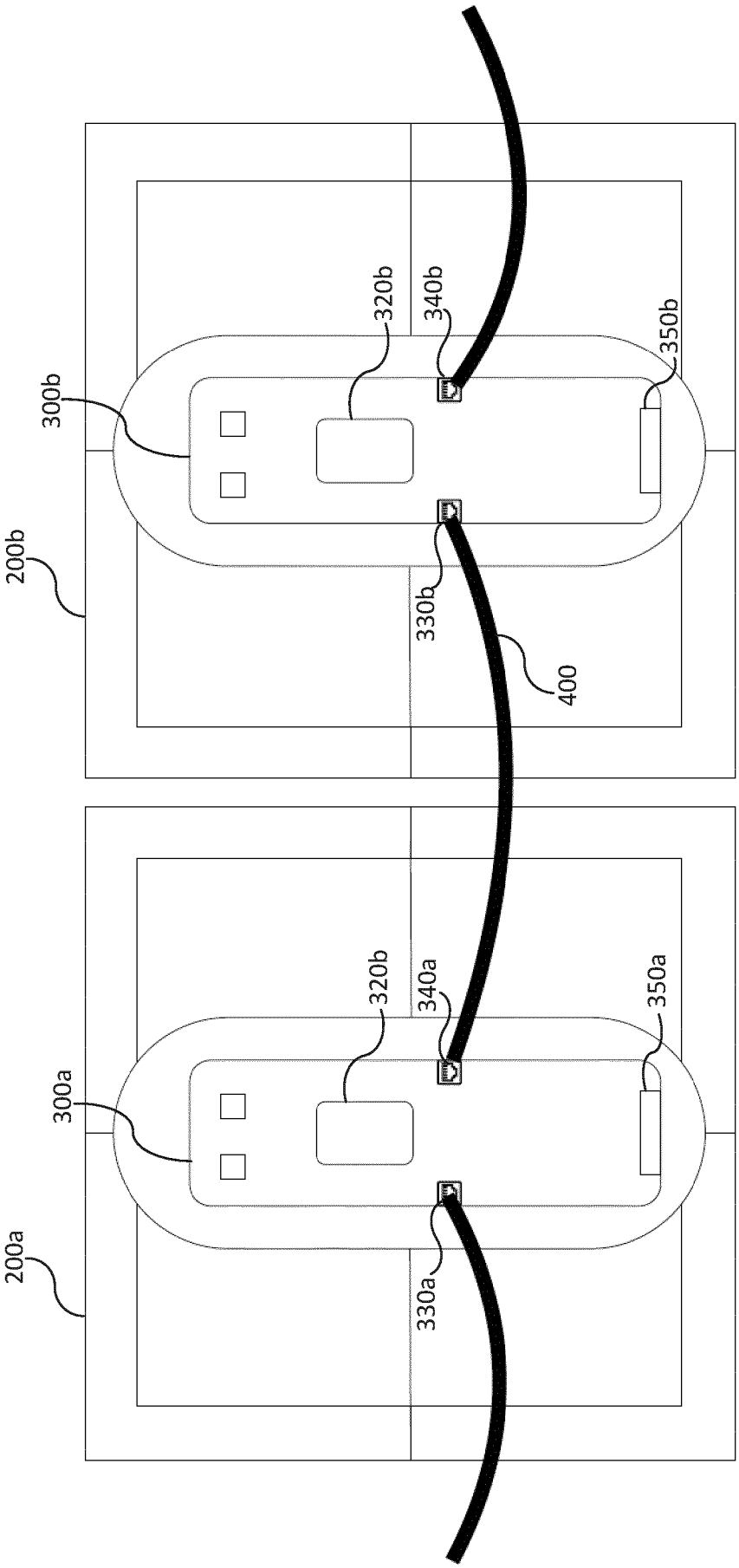
200b
300b
320b
340b
350b
330b
400
200a
300a
320b
340a
350a
330a

Figure 3

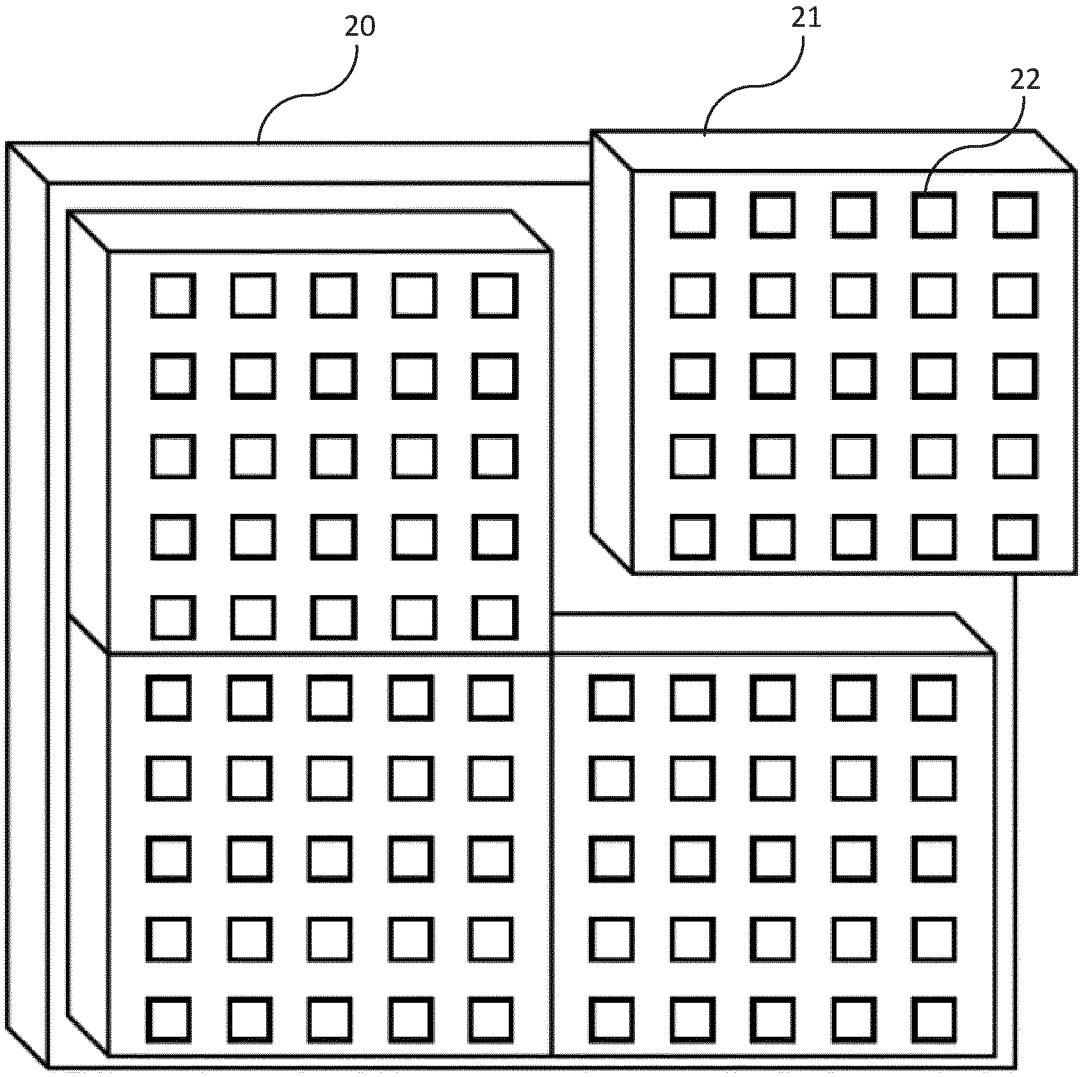

Figure 4

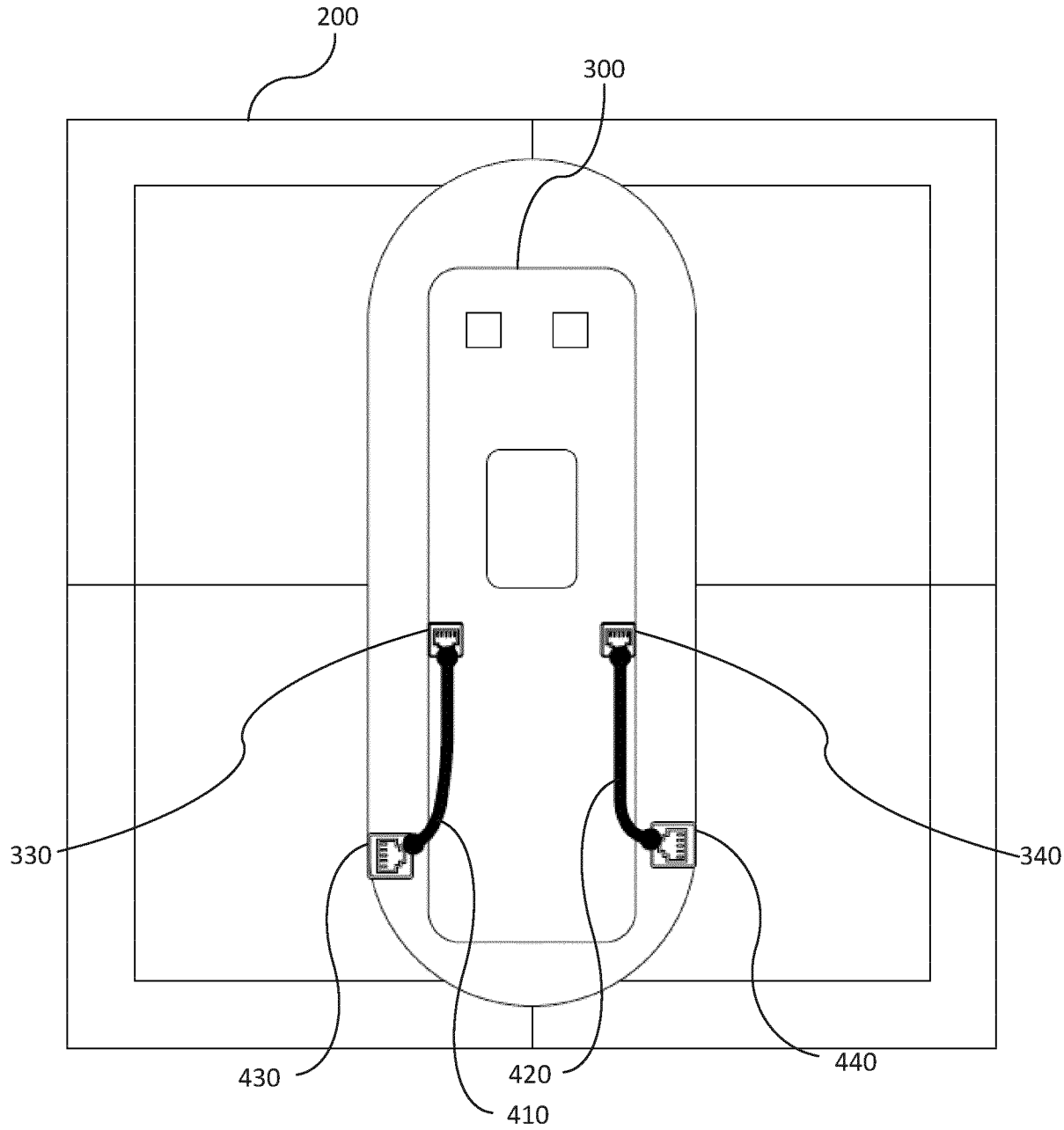

Figure 5

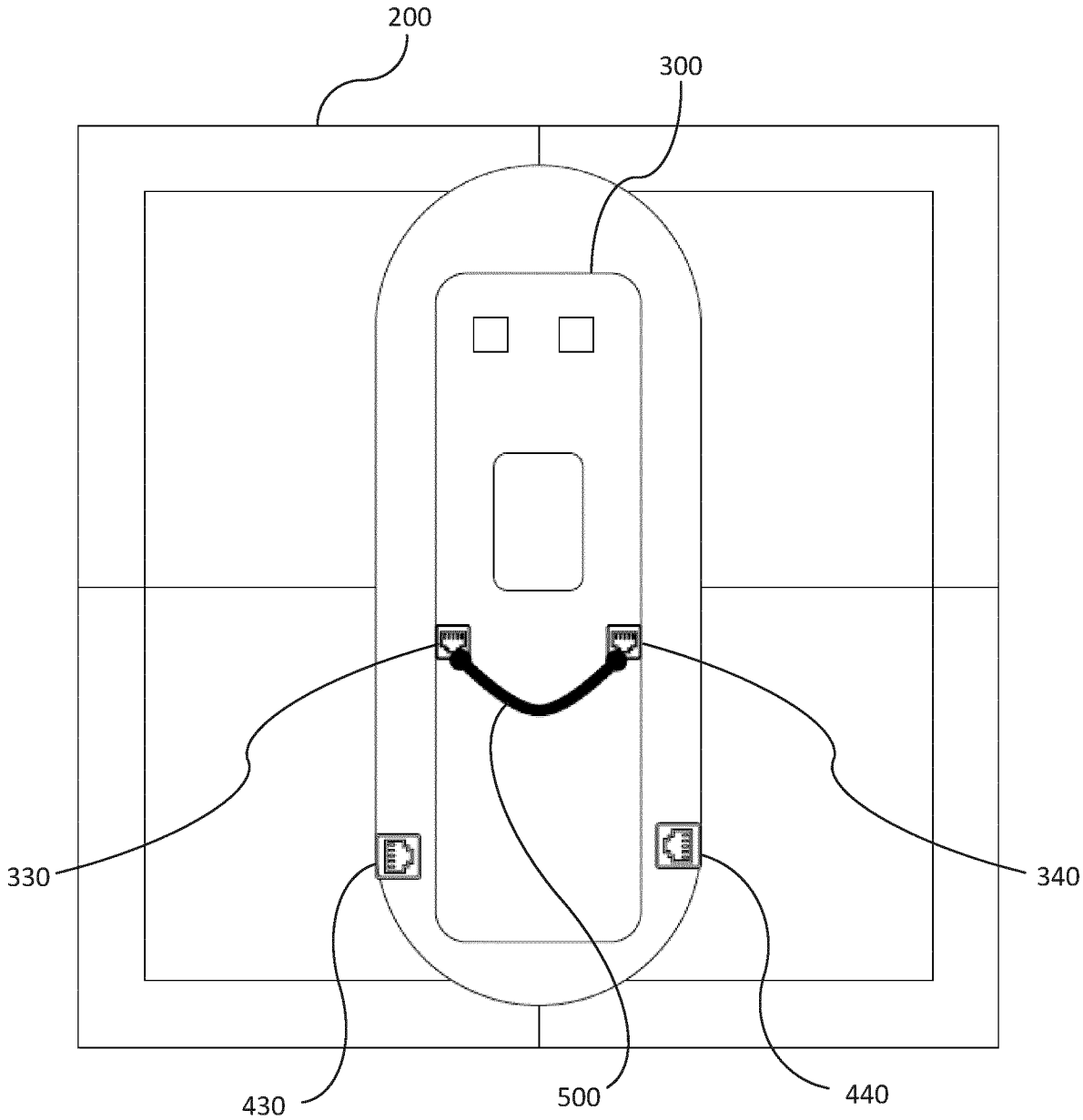

Figure 6

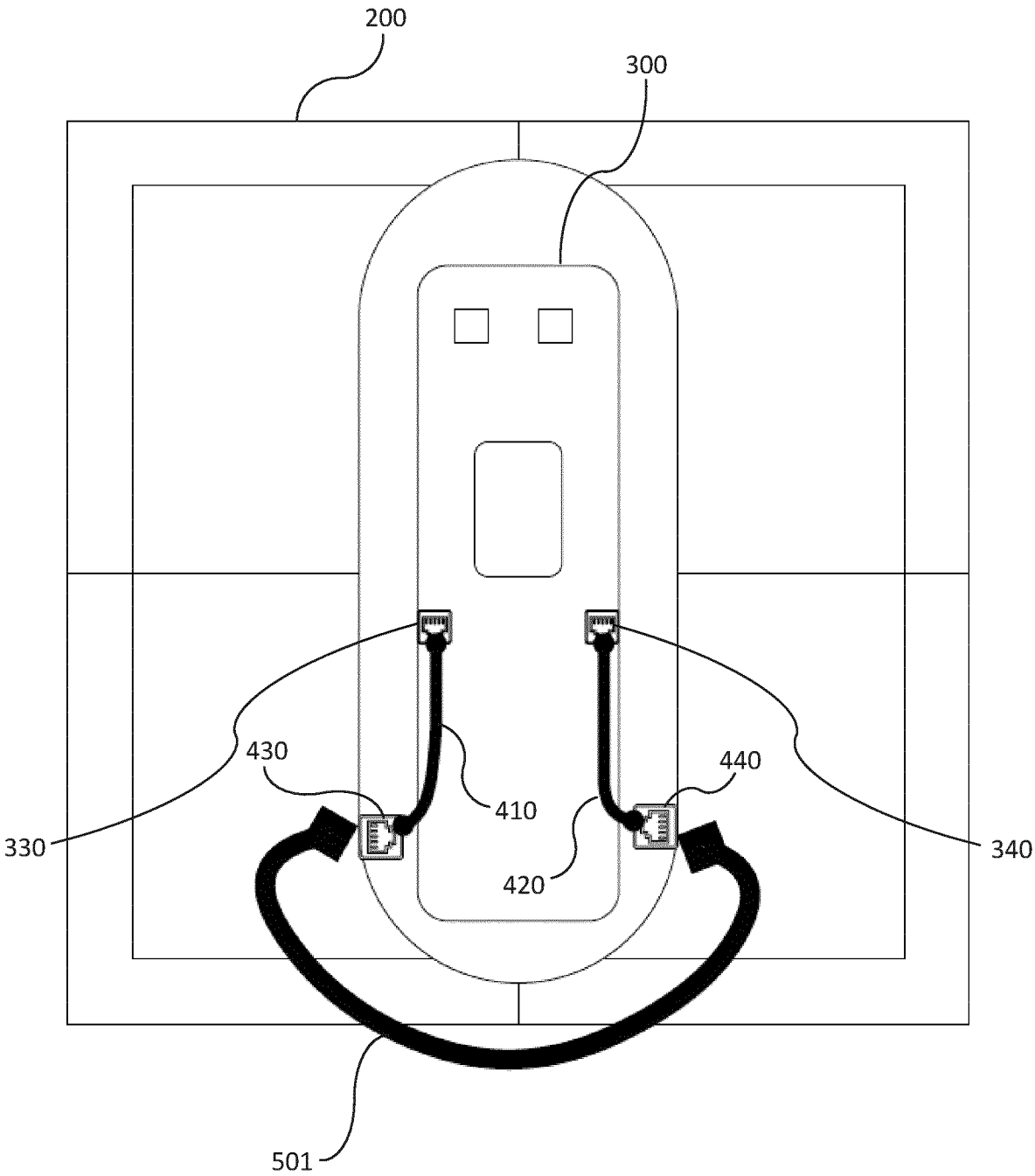

Figure 7

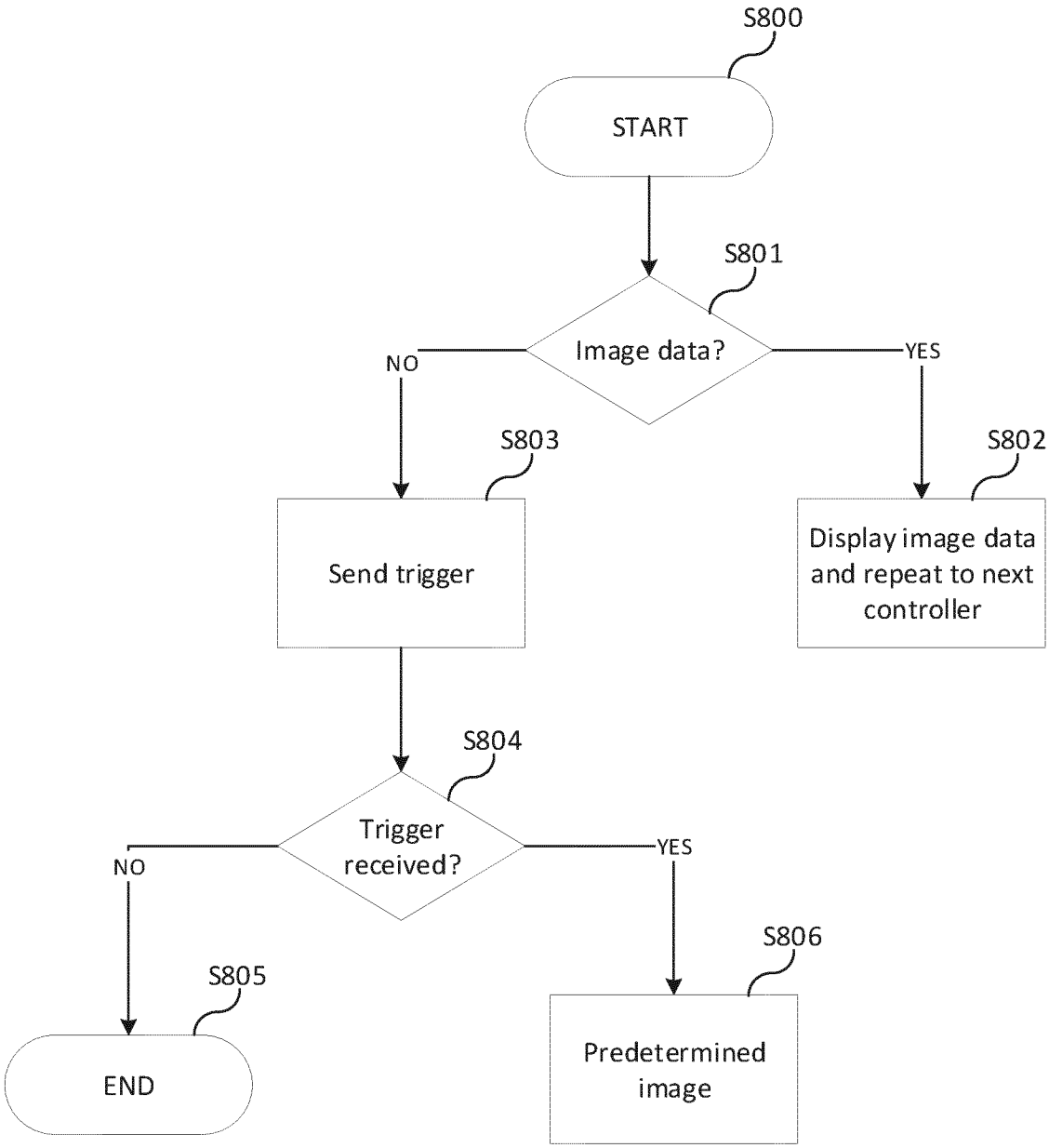
S800
START
S801
Image data?
NO
YES
S803
Send trigger
S802
Display image data and repeat to next controller
S804
Trigger received?
NO
YES
S805
END
S806
Predetermined image

Figure 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2021/057818

A. CLASSIFICATION OF SUBJECT MATTER
INV. G09G5/00 G09G3/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G09G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 682 934 A1 (SAMSUNG ELECTRONICS CO LTD [KR]) 8 January 2014 (2014-01-08) paragraph [0042] - paragraph [0101]	1,2,4-15
X	US 9 565 427 B1 (BLAKE JOSHUA [US] ET AL) 7 February 2017 (2017-02-07) column 3, line 25 - column 6, line 35; figures 1-7	1-5, 8-11, 13-15
A	US 2001/025330 A1 (OI KENJI [JP] ET AL) 27 September 2001 (2001-09-27) paragraph [0098] - paragraph [0161]	1-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 October 2021	04/11/2021

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Njibamum, David

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2021/057818

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		WO 2014007459 A1	09-01-2014
US 9565427 B1	07-02-2017	CA 3020299 A1	24-08-2017
		CN 108353162 A	31-07-2018
		EP 3350990 A1	25-07-2018
		US 9565427 B1	07-02-2017
		WO 2017142960 A1	24-08-2017
US 2001025330 A1	27-09-2001	NONE	