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- **Japanese Unexamined Patent Application Publication No.: JP H4-15853**

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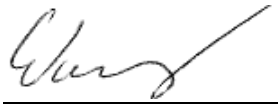

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SPECIFICATION

1. Title of the Invention

SCSI Device Adapter

2. Scope of Patent Claims

(1) A SCSI device adapter, comprising:

a SCSI interface that is connected to a SCSI interface for connecting an EWS (Engineering WorkStation) device;

a device interface for connecting to a peripheral device;

a data writing portion, a data reading portion, a control data writing portion, and an interrupt data reading portion that are identified with different ID numbers (or with identical ID numbers and different unit numbers) from the EWS through the SCSI interface;

a code converting portion for converting data between a SCSI format and a peripheral device bus format, positioned between the data writing portion and data reading portion and a device interface;

a controlling portion for controlling sending and receiving of data between the EWS and the peripheral device, carried out through relaying through the data writing portion and reading portion; and

an interrupt controlling device for outputting, to the EWS, through the SCSI interface, a disconnect signal when, for an interrupt data read command sent from the EWS, the interrupt data is not ready in the interrupt data reading portion, to release the EWS circuit, and for sending, to the EWS, through the SCSI interface, a reconnect signal when interrupt data has been inputted from the interrupt data reading portion thereafter, to enable the EWS to read out the interrupt data.

3. Detailed Explanation of the Invention

[STAMP INDICATING THAT THIS IS A VALID AMENDMENT TO A DIFFERENT SPELLING OF THE SAME MESSAGE]

[Area of Use in Industry]

The present invention relates to a general-use SCSI device able to connect easily PC peripheral devices and devices such as sequencers to a SCSI interface of an EWS (Engineering WorkStation).

[Prior Art and Problem Solved by the Present Invention]

Engineering workstations, given their multi-tasking, multi-windowing processing and comparatively inexpensive equipment structure enable high-speed data processing, and are used by consumers.

An EWS is equipped with a SCSI interface, as a standard interface, for the purpose of connecting a hard disk or a magnetic tape device. However, it does not have a slot for an expansion board, such as in a PC. Consequently, it has not been possible to connect directly, to an EWS, output devices such as plotters, or sequencers, or the like, that have a PC I/O bus or a

bidirectional parallel bus with interrupts, which are PC-compatible buses. That is to say, because the existing EWS has only an initiator function, adapters cannot be wired and connected to an EWS.

Note that while a personal computer has a high degree of flexibility in connecting peripheral devices through the use of expansion slots, the processing uses a single stack, so the processing speed is slow and impractical. Moreover, while high-end EWSs are provided with specialized buses for connecting peripheral devices, they are compatible only with specific devices, and are unable to connect freely to arbitrary devices, and the system structure is extremely expensive.

If peripheral devices that have PC-compatible buses are to be connected to EWSs, then a code converter for converting codes between [those of] the SCSI interface that is the standard equipment that is designed compatible with the existing hard disks, and [those of] the GPIB interface, for example, that is a PC-compatible bus, should be manufactured.

However, the existing SCSI interface that is designed for hard disk use has no interrupt function, and thus cannot be connected to a device that requires interrupts to be applied to the host side, such as a sequencer, or the like.

Given this, the object of the present invention is to provide a general-use SCSI device adapter that can easily connect a peripheral device that has a standard bus that is different from that of an SCSI bus, such as a PC-compatible bus, or the like, to the SCSI interface of an EWS that was built for the purpose of connecting with a hard disk, and, in particular, to provide a general-use SCSI device adapter that can apply an interrupt from the peripheral device side.

[MEANS FOR SOLVING THE PROBLEM]

The present invention provides a SCSI device adapter, comprising: a SCSI interface that is connected to a SCSI interface for connecting an EWS (Engineering WorkStation) device; a device interface for connecting to a peripheral device; a data writing portion, a data reading portion, a control data writing portion, and an interrupt data reading portion that are identified with different ID numbers (or with identical ID numbers and different unit numbers) from the EWS through the SCSI interface; a code converting portion for converting data between a SCSI format and a peripheral device bus format, positioned beteen the data writing portion and data reading portion and a device interface; a controlling portion for controlling sending and receiving of data between the EWS and the peripheral device, carried out through relaying through the data writing portion and reading portion; and an interrupt controlling device for outputting, to the EWS, through the SCSI interface, a disconnect signal when, for an interrupt data read command sent from the EWS, the interrupt data is not ready in the interrupt data reading portion, to release the EWS circuit, and for sending, to the EWS, through the SCSI interface, a reconnect signal when interrupt data has been inputted from the interrupt data reading portion thereafter, to enable the EWS to read out the interrupt data.

[OPERATION]

The SCSI device adapter performs input/output of data to/from an EWS SCSI interface through the same standard as the SCSI interface for a hard disk, the EWS to write and read arbitrary data to/from four types of data writing portions and reading portions that function as data relays with the peripheral device.

Moreover, this SCSI device adapter performs input and output of data to/from the peripheral device through the interface for the device through the bus standard of that device, and converts the data thereof, through the code converting portion, to data of the SCSI standard, to input/output to/from the four types of data writing portions and reading portions.

When there is no data ready in the interrupt data reading portion in response to an interrupt data read command from the EWS, the interrupt controlling portion uses a SCSI-standard Disconnect signal and Reconnect signal to release the EWS line, and then, thereafter, cause the data to be read out once the data is ready.

This operation enables a device that requires interrupts to be connected to the SCSI interface of an EWS that was designed for connecting a hard disk, through causing a virtual interrupt operation, in a SCSI interface for an EWS that has not been designed for interrupts.

[EMBODIMENTS]

An example of a structure wherein a peripheral device is connected to an EWS using a SCSI interface converter according to one embodiment according to the present invention will be explained using FIG. 1.

In this figure, (1) is a relatively inexpensive EWS (Engineering WorkStation) of a desktop type, and has, as standard equipment, a SCSI interface (2) for connecting a hard disk. (3) is a SCSI device adapter that is assembled in a single board, peripheral devices, such as, for example, an output device (4), such as a plotter, an input device (5), such as a CD-ROM, and a device (6) that carries out interrupt control of a sequencer, or the like, are connected to the EWS (1).

The SCSI device adapter (3) has a SCSI interface (7) for connecting to the EWS (1), and has, as a device interface for connecting peripheral devices, PC I/O bus interfaces (8) and (9), and a bidirectional interrupt-capable parallel bus interface (10). Moreover, in the SCSI device adapter (3), a data writing portion (11), a data reading portion (12), a

control data writing portion (13), and an interrupt data reading portion (14) that are identified with different ID numbers N, N + 1,…, N + 3 (or with identical ID numbers and different unit numbers N, N + 1,…, N + 3) through the SCSI interfaces (2) and (7) from the EWS (1), a code converting portion (15) for converting to a data format between the SCSI standard and a bus standard of the interface for the device, between the individual data writing portions and data reading portions (11), (12), (13), and (14) and the device interfaces (8), (9), and (10), a controlling portion (16) for controlling sending and receiving of data between the EWS and the peripheral device that is carried out relayed by the aforementioned data writing and reading portions; and an interrupt controlling portion (17) for generating a control signal so as to enable the EWS (1) to receive an interrupt signal from a device through the SCSI interfaces (2) and (7) without interrupting processing, are structured from a microcomputer, a ROM, and a RAM.

Note that the device interface of the SCSI device adapter (3) may also use, depending on the connected device, other types of I/O bus interfaces (8) and (9) and bidirectional interrupt-compatible parallel interfaces (10) from those described above. For example, an A/D converter (19) able to input analog data from an analog device (18), such as a sensor, may be built in. Here the device interface may be an RS-232, a standard interface such as a Centronics or VME bus, or a specialized interface such as an expansion bus of a specific PC.

The EWS device adapter (3), structured as described above, operates as follows.

The SCSI interface of the EWS (1) is designed so as to enable connection of up to 8 hard disks. Given this, in the present invention ID numbers (or a single ID number with different unit numbers) (N, N + 1,…, N + 3) are assigned to the individual writing portions and reading portions (11) through (14) so as to enable identification, as perceived by the EWS (1), of the data writing portion of (11), the data reading portion (12), the control data writing portion (13), and the interrupt data reading portion (14), as four of those hard disk devices. That is, the EWS (1) merely operates by reading from, or writing to, the individual writing portions and reading portions using the same procedure as for four hard disk devices.

On the other hand, the controlling portion (16) controls the inputting and outputting of data from/to the peripheral devices (4), (5), and (6) through the device interfaces (8), (9) and (10). That is, it outputs, to an output device (4) such as a plotter, the data that is written to the data writing portion (11), inputs, into the data reading portion (12) the data that has been written in from an input device (5), such as a CD-ROM, or the like, outputs, to the device (6) that carries out interrupt control, such as a sequencer, data that has been written to the control data writing portion (13), and inputs, into the interrupt data reading portion (14), interrupt data from the device (6) that carries out interrupt control. The input/output control of the controlling portion (17) is carried out with prescribed timing through decoding of commands sent from the EWS (1). Note that in the exchange of data between the device interfaces (8), (9), and (10) and the individual data writing portions and reading portions (11), (12), (13), and (14), code conversion between the SCSI standard and the various bus standards is carried out through the interposition of the code converting portion (15). Moreover, even if the device interfaces (8), (9), and (10) each have respective pluralities of channels, control is possible through the code converting portion (15), the controlling portion (16), and the interrupt controlling portion (17).

In the present invention, the EWS (1) recognizes the individual writing portions and reading portions (11), (12), (13), and (14) as individual devices, and thus, in the EWS (1), the processing efficiency is high, as the different writing programs and reading programs for the individual writing portions and reading portions (11), (12), (13), and (14) are launched simultaneously and processed in parallel.

The major distinctive feature of the present invention is that virtual interrupts are caused to be carried out, from the device side, in the SCSI interface (2) of an EWS (1) that was not designed for interrupts. That is, when there is a read command from the EWS (1) to the interrupt data reading portion (14), if interrupt data is not ready (where, unlike the case wherein data is ready in response to a read command from the EWS (1) in a CD-ROM inputting device (1), here the interrupt is made with unspecified timing depending on the status on the device side, so often the interrupt data is not ready), the interrupt controlling portion (17) sends a Disconnect signal to the EWS (1) to release the EWS circuit. This enables the EWS (1) to carry out other processes. When, thereafter, interrupt 12 data is ready in the interrupt data reading portion (14), the interrupt controlling portion (17) sends a Reconnect signal to the EWS (1). The EWS (1) that has received this signal carries out interrupt data reading, to complete the reading of the interrupt data by the EWS (1).

The operation described above will be explained in the series of operations in the SCSI driver (software) of the EWS (1). The EWS SCSI driver was developed as a driver for connecting a hard disk. As a result, the device of the present invention acts as an emulation of a hard disk. The procedure sequence is

performed following the flowchart illustrated in FIG. 2.

In this flowchart, the "Start" through "Mode Sense" is the hard disk initializing procedure, where "Inquiry" is information for the properties of the target and logical unit (the device type identification code); the "Start/Stop unit" starts/stops the logical unit; the "Test Unit Ready" is a test of whether or not the logical unit is in a usable state; and the "Mode Sense" is information for the various parameter values (data format and structure of the recording medium). Through this, the individual writing portions and reading portions (11), (12), (13), and (14) go into an active state, relative to the EWS (1).

After the initializing sequence, the EWS (1) executes reading from, or writing to, the individual writing portions and reading portions (11), (12), (13), and (14). Specifically, the "Read Extended" reads out a specified block, that is, reads the data reading portion (12) or the interrupt data reading portion (14), and the "Write Extended" writes data to a specified block, that is, writes data to the data writing portion (11) or the control data writing portion (13).

Because the procedure above uses the SCSI standard, the present device can be connected to the SCSI interface of an EWS (1) easily, with essentially no modification.

In this standardized procedure, the explanation will be for a procedure for carrying out control of a device that has various types of interfaces, such as, for example, those that are PC-compatible. The control of the various types of devices is divided into writing to memory, writing commands, and reading interrupt signals from the device. In the device according to the present invention, the various functions are divided among the four units that are the writing portions and the reading portions (11), (12), (13), and (14), and thus, in the EWS, programs for both writing and reading are activated simultaneously. Among these functions, the reading of interrupt data is carried out as in the flowchart illustrated in FIG. 3, enabling virtual interrupts in a SCSI interface that was not designed for interrupts.

At first, a read command is outputted by the EWS to the interrupt data reading portion (14). This reading must be performed periodically in anticipation of the timing with which the device produces interrupts. At this time, usually no interrupt data will be ready, so the interrupt controlling portion (14) sends a Disconnect signal to the EWS (1) to release the line of the EWS (1), to enable it to carry out other processing. Following this, when a device interrupt is produced and the interrupt data is ready, the interrupt controlling portion (17) outputs a Reconnect signal to the EWS (1), to cause the EWS (1) to read in the interrupt data from the interrupt data reading portion (14). When transmission of the interrupt data to the EWS (1) has been completed, then, in the EWS (1), the execution of the read command is completed.

[EFFECTS OF THE INVENTION]

Given the present invention, a device that has an interface that requires interrupts can be connected easily to a SCSI interface in an EWS that was not designed for interrupts.

Moreover, in this invention, four writing portions and reading portions are provided that are identified as different logical devices when reading/writing data, writing commands, and reading interrupt data between the EWS and the device, enabling high-speed processing through being able to start, simultaneously, programs for writing and reading in the EWS.

4. BRIEF DESCRIPTIONS OF THE DRAWINGS

FIG. 1 is a block diagram of a SCSI device adapter according to one embodiment according to the present invention, connected between an EWS and a device; FIG. 2 is a flowchart illustrating an operating procedure of an EWS in connection to FIG. 1; and FIG. 3 is a flowchart illustrating an interrupt data reading procedure in the configuration in FIG. 1.

(1): EWS
(2), (7): SCSI Interface
(3): SCSI Device Adapter
(4), (5), (6): Peripheral Device
(8), (9), (10): Device Interfaces
(11): Data Reading Portion
(12): Data Writing Portion
(13): Control Data Writing Portion
(14): Interrupt Data Reading Portion
(15): Code Converting Portion
(16): Controlling Portion
(17): Interrupt Controlling Portion

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