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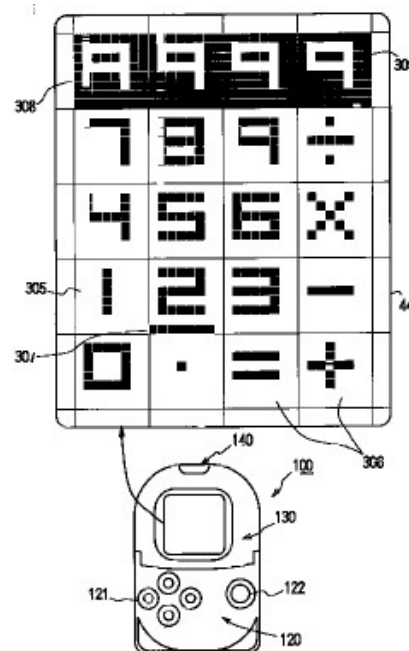
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(54) [Title of Invention] PORTABLE ELECTRONIC DEVICE FOR ENTERTAINMENT SYSTEM

(57) [Abstract]

[Problem to be Solved] To provide technology for using a portable electronic device capable of executing games as a calculator.

[Solution] A portable electronic device provided with an interface for connecting to a parent machine having a program execution function, comprising a program storage means, a control means that controls execution of the program, a display means that displays information according to the executed program, an operation input means for operating the program, and a power supply means that supplies power to each of the means, wherein information accompanying execution of a calculator program is transferred from the parent machine to the portable electronic device, and the control means executes the calculator program stored in the program storage means based on the transferred information.



[SCOPE OF THE PATENT CLAIMS]

[Claim 1] A portable electronic device provided with an interface for connecting to a parent machine having a program execution function, comprising
a program storage means,
a control means that controls execution of the program,
a display means that displays information according to the executed program,
an operation input means for operating the program,
a power supply means that supplies power to each of the means,
wherein information accompanying execution of a calculator program is transferred from the parent machine to the portable electronic device, and the control means executes the calculator program stored in the program storage means based on the transferred information.

[Claim 2] The portable electronic device according to claim 1, wherein the calculator program stored in the program storage means is executed in a state in which the connection with the parent machine is severed.

[Claim 3] The portable electronic device according to claim 1, wherein the connected parent machine is a video game device, the calculator program is downloaded from the connected parent machine to the storage means, and the program is executed by the control means.

[Claim 4] The portable electronic device according to claim 1, wherein the calculator program is recorded additionally on an optical disk recording medium on which game software is accumulated and which is mounted on the parent machine.

[Claim 5] The portable electronic device according to claim 1, wherein the characters of the number-specifying keys and operation keys and the numerical value characters of the calculation results displayed on the display means are distinguishable.

[Claim 6] The portable electronic device according to claim 5, wherein the characters of the number-specifying keys and operation keys displayed on the display means are displayed normally, and the numerical value characters of the calculation results are displayed as characters whose intensity is reversed.

[Claim 7] The portable electronic device according to claim 1, wherein the number-specifying keys, operation keys, and calculation results are partially displayed on a relatively small display screen of the display means, and the partial display can be scrolled to successively display the entire view.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Technical Field of the Invention] The present invention relates to a portable electronic device for an entertainment system, and more specifically to technology for using as a calculator (desktop electronic calculator) a portable electronic device that can be connected to an information device such as a video game machine, has a function as an auxiliary storage device such as a memory card device, and can also be used independently.

[0002]

[Background Art] A conventional portable electronic device or child machine such as a memory card device used by being inserted into a parent machine such as an information device like a video game machine is configured to have an interface for connecting to the main unit (parent machine) of the information device and a nonvolatile storage element for storing data.

[0003] Figure 25(a) shows an example of a configuration of a main part of such a conventional portable electronic device as a memory card device. A conventional memory card 10 includes a control means 11 for controlling operation thereof, a connector 12 for connecting to terminals provided in a slot of the information device, and a nonvolatile memory 16 for storing data, and the connector 12 and the nonvolatile memory 16 are connected to the control means 11. The control means 11 is configured using, for example, a microcomputer (abbreviated as microcomputer in the drawings). Also, a flash memory such as EEPROM is used for the nonvolatile memory 16. Furthermore, a microcomputer is sometimes used as a control means for interpreting protocols for the connection interface with the information device.

[0004] Figure 25(b) shows control items in the control means 11 of the conventional memory card 10.

[0005] Thus, the conventional memory card only has a main unit connection interface for connecting to the main unit of the information device and a memory interface for inputting and outputting data to and from the nonvolatile memory.

[0006] Furthermore, a conventional video game device such as a home TV game device has a function of storing game data and the like in an auxiliary storage device. The above-mentioned memory card device is also used as an auxiliary storage device of such a video game device.

[0007] Figure 26 shows an example of a conventional video game device using a memory card as an auxiliary storage device. A main unit 2 of the conventional video game device 1 is housed in a roughly square-shaped housing and comprises a disk mounting unit 3 in the center, on which an optical disk, which is a recording medium on which a video game application program is recorded, is mounted, a reset switch 4 for arbitrarily resetting the game, a power switch 5, a disk operation switch 6 for operating the mounting of the optical disk, and, for example, two slots 7A and 7B.

[0008] The memory card 10 used as an auxiliary storage device is inserted into the slots 7A and 7B, and, for example, results of games executed on the video game device 1 are sent from the control means (CPU) 19 and written into the nonvolatile memory 16. Note that multiple operation devices (controllers), not shown, are also connected to the slots 7A and 7B, allowing multiple users to simultaneously play competitive games.

[0009]

[Problem to be Solved] Meanwhile, it has been desired that a child machine connected by utilizing the memory card slot of a parent machine such as a video game device should have a program execution function such as for games. Such a child machine can also be used as a portable electronic device as is, and by facilitating communication with other devices, the range of applications is expanded, leading to the stimulation of new demand. Furthermore, it would be very convenient if such a portable electronic device could be used as a calculator (desktop electronic calculator).

[0010] The present invention has been devised in view of such circumstances, and has as an object to provide technology for using as a calculator a portable electronic device that can be connected to a parent machine and can also be used as an individual child machine.

[0011]

[Means for Solving the Problem] In order to solve the above problems, the portable electronic device according to the present invention is a portable electronic device provided with an interface for connecting to a parent machine having a program execution function, comprising a program storage means, a control means that controls execution of the program, a display means that displays information according to the

executed program, an operation input means for operating the program, and a power supply means that supplies power to each of the means, wherein information accompanying execution of a calculator program is transferred from the parent machine to the portable electronic device, and the control means executes the calculator program stored in the program storage means based on the transferred information.

[0012] Furthermore, the portable electronic device according to the present invention is the above-mentioned portable electronic device, wherein the calculator program stored in the program storage means is executed in a state in which the connection with the parent machine is severed.

[0013] Furthermore, the portable electronic device according to the present invention is the above-mentioned portable electronic device, wherein the connected parent machine is a video game device, the calculator program is downloaded from the connected parent machine to the storage means, and the program is executed by the control means.

[0014] Furthermore, the portable electronic device according to the present invention is the above-mentioned portable electronic device, wherein the calculator program is recorded additionally on an optical disk recording medium on which game software is accumulated and which is mounted on the parent machine.

[0015] Furthermore, the portable electronic device according to the present invention is the above-mentioned portable electronic device, wherein the characters of the number-specifying keys and operation keys and the numerical value characters of the calculation results displayed on the display means are distinguishable.

[0016] Furthermore, the portable electronic device according to the present invention is the above-mentioned portable electronic device, wherein the characters of the number-specifying keys and operation keys displayed on the display means are displayed normally, and the numerical value characters of the calculation results are displayed as characters whose intensity is reversed.

[0017] Furthermore, the portable electronic device according to the present invention is the above-mentioned portable electronic device, wherein the number-specifying keys, operation keys, and calculation results are partially displayed on a relatively small display screen of the display means, and the partial display can be scrolled to successively display the entire view.

[0018]

[Embodiments of the Invention] Preferred embodiments of the present invention will be described with reference to the drawings. Here, the portable electronic device that is an embodiment of the present invention can be used as a memory card device used in an entertainment system such as a video game device that serves as a parent machine, and can also be used independently as a portable small game machine. Note that the parent machine is not limited to a video game machine, and the portable electronic device serving as a child machine need not necessarily have a memory card function.

[0019] In the following description, first, an example of a parent machine in which the portable electronic device that is an embodiment of the present invention is used as a child machine will be described, taking a video game device as an example.

[0020] Figure 1 shows the outer appearance of a video game device on which the portable electronic device that is an embodiment of the present invention is mounted as a parent machine. A video game device 1 is, for example, for reading a game program recorded on an optical disk or the like and executing same

according to instructions from a user (game player). Note that execution of a game mainly means controlling the progress of the game, as well as display and sound.

[0021] [General Video Game Device] The main unit 2 of the video game device 1 is housed in a roughly square-shaped housing, and is constituted so as to have a disk mounting unit 3 in the center, on which an optical disk such as a CD-ROM, which is a recording medium for supplying video game and other application programs, is mounted, a reset switch 4 for arbitrarily resetting the game, a power switch 5, a disk operation switch 6 for operating the mounting of the optical disk, and, for example, two slots 7A and 7B.

[0022] Note that the recording medium for supplying application programs is not limited to optical disks, and application programs may be supplied via a communication circuit.

[0023] The slots 7A and 7B can connect two operation devices 20, allowing two users to play competitive games. Also, the slots 7A and 7B can accept insertion of the above-mentioned memory card device or the portable electronic device 100 that is an embodiment of the present invention. Note that Figure 1 illustrates a structure with two systems of slots 7A and 7B, but the number is not limited to two systems.

[0024] The operation device 20 has first and second operation sections 21 and 22, an L button 23L and an R button 23R, a start button 24, and a select button 25, and further analog operation sections 31 and 32, a mode selection switch 33 for selecting the operation mode of these operation sections 31 and 32, and a display section 34 for displaying the selected operation mode. Additionally, an internal vibration mechanism, not shown, is provided inside the operation device 20.

[0025] Figure 2 shows the state of the slots 7A and 7B provided on the front of the main unit 2 of the above video game device 1.

[0026] In this embodiment, the slots 7A and 7B are each formed in two stages, with the upper stage provided with memory card insertion sections 8A and 8B into which the above-mentioned memory card 10 or a portable electronic device 100 to be described later is inserted, and the lower stage provided with controller connection sections (jacks) 9A and 9B to which the connection terminal parts (connectors) 26 of the controllers 20 are connected.

[0027] The insertion holes (slots) of the memory card insertion sections 8A and 8B are formed in a horizontally long rectangular shape, with the corners at both ends of the lower side having more rounding than the corners at both ends of the upper side, so that the memory card cannot be inserted in the wrong orientation. Also, the memory card insertion sections 8A and 8B are provided with shutters for protecting the connection terminals inside that obtain electrical connection.

[0028] On the other hand, the controller connection sections 9A and 9B have insertion holes formed in a horizontally long rectangular shape, with the corners at both ends of the lower side having more rounding than the corners at both ends of the upper side, so that the connection terminal parts 26 of the controllers 20 cannot be connected in the wrong orientation, and the insertion hole shapes differ from those of the memory card insertion sections 8A and 8B to prevent erroneous insertion of memory cards.

[0029] Figure 3 shows a state in which the portable electronic device 100 that is an embodiment of the present invention is inserted into the memory card insertion section 8A of the slot 7A on the front of the video game device 1.

[0030] Next, Figure 4 is a block diagram showing an example of a schematic circuit configuration of the main part of the above video game device 1.

[0031] The video game device 1 is constituted by a control system 50 including a central processing unit (CPU) 51 and peripheral devices thereof, a graphic system 60 including an image processing device (GPU: Graphic Processing Unit) 62 that performs drawing on a frame buffer 63, a sound system 70 including a sound processing device (SPU: Sound Processing Unit) that generates musical tones, sound effects, etc., an optical disk control unit 80 that controls an optical disk on which an application program is recorded, a communication control unit 90 that controls input and output of data from a controller 20 from which instructions are input by a user and a memory card 10 or the portable electronic device 100 to be described later that stores game settings and the like, and a bus BUS or the like connecting the above units.

[0032] The control system 50 includes the CPU 51, a peripheral device control unit 52 that controls interrupt control and direct memory access (DMA) transfer control, a main memory (primary storage device) 53 consisting of a random access memory (RAM), a main memory 53, and a read-only memory (ROM) 54 in which programs such as an operating system managing the main memory 53, the graphic system 60, the sound system 70, and the like are stored. Note that the main memory here means a memory on which programs can be executed.

[0033] The CPU 51 controls the entire video game device 1 by executing the operating system stored in the ROM 54, and is, for example, a 32-bit RISC-CPU.

[0034] When the power is turned on, the video game device 1 causes the CPU 51 of the control system 50 to execute the operating system stored in the ROM 54, so that the CPU 51 controls the graphic system 60, the sound system 70, and the like. Also, when the operating system is executed, the CPU 51 performs overall initialization of the video game device 1 such as operation check, then controls the optical disk control unit 80 to execute application programs such as games recorded on the optical disk. By executing such game programs, the CPU 51 controls the graphic system 60, the sound system 70, and the like according to input from the user, controlling image display, sound effects, and musical tone generation.

[0035] The graphic system 60 includes a geometry transfer engine (GTE) 61 that performs processing such as coordinate transformation, a GPU 62 that performs drawing according to drawing instructions from the CPU 51, a frame buffer 63 that stores images drawn by the GPU 62, and an image decoder 64 that decodes image data compressed and encoded by orthogonal transforms such as discrete cosine transforms.

[0036] The above-mentioned GTE 61 is provided with, for example, a parallel computation mechanism that executes multiple calculations in parallel, and can perform coordinate transformation, light source calculation, and calculations of matrices or vectors at high speed in response to computation requests from the CPU 51. Specifically, in the case of performing flat shading, which draws a single triangle-shaped polygon with the same color, the GTE 61 can perform coordinate calculations for up to approximately 1.5 million polygons per second, thereby reducing the load on the CPU 51 and enabling high-speed coordinate calculations in this video game device.

[0037] The above-mentioned GPU 62 performs drawing of polygons and the like on the frame buffer 63 according to drawing instructions from the CPU 51. The GPU 62 can draw up to approximately 360,000 polygons per second.

[0038] Furthermore, the above-mentioned frame buffer 63 consists of so-called dual-port RAM, enabling simultaneous drawing from the GPU 62 or transfer from the main memory and reading for display. This frame buffer 63 has, for example, a capacity of 1 Mbyte and is treated as a matrix consisting of 16-bit pixels with 1024 pixels horizontally and 512 pixels vertically. In addition to the display area output as video

output, the frame buffer 63 is provided with a CLUT (Color Look Up Table) area storing a CLUT referenced by the GPU 62 when drawing polygons and the like, and a texture area storing textures inserted (mapped) into polygons drawn by the GPU 62 after coordinate transformation during drawing. These CLUT and texture areas are dynamically changed according to changes in the display area and the like.

[0039] Note that, in addition to the above flat shading, the above-mentioned GPU 62 can perform Gouraud shading that determines the color inside a polygon by interpolation from the colors of the polygon's vertices, and texture mapping that applies textures stored in the above texture area onto polygons. When performing Gouraud shading or texture mapping, the above GTE 61 can perform coordinate calculations for up to approximately 500,000 polygons per second.

[0040] Furthermore, the image decoder 64 decodes still or moving image data stored in the main memory 53 under control from the CPU 51 and stores the decoded data in the main memory 53.

[0041] Also, the reproduced image data can be used as a background of images drawn by the above GPU 62 by storing same in the frame buffer 63 via the GPU 62.

[0042] The aforementioned sound system 70 includes an SPU 71 that generates musical tones, sound effects, and the like based on instructions from the CPU 51, a sound buffer 72 in which waveform data and the like are recorded by the SPU 71, and a speaker 73 that outputs the musical tones, sound effects, and the like generated by the SPU 71.

[0043] The aforementioned SPU 71 includes an ADPCM decoder function that plays back audio data encoded by adaptive differential pulse code modulation (ADPCM) as 16-bit audio data represented as 4-bit differential signals, a playback function that generates sound effects and the like by playing back waveform data stored in the sound buffer 72, and a modulation function that modulates and plays back waveform data stored in the sound buffer 72.

[0044] By having such functions, the sound system 70 can be used as a so-called sampling sound source that generates musical tones, sound effects, and the like based on waveform data recorded in the sound buffer 72 according to instructions from the CPU 51.

[0045] The above optical disk control unit 80 includes an optical disk device 81 that reproduces programs and data recorded on an optical disk, a decoder 82 that decodes programs and data recorded with error correction codes (ECC) added, and a buffer 83 that temporarily stores data from the optical disk device 81 to speed up reading of data from the optical disk. A sub-CPU 84 is connected to the decoder 82.

[0046] Also, as audio data recorded on the optical disk read by the optical disk device 81, in addition to the above ADPCM data, there is so-called PCM data obtained by analog/digital conversion of audio signals.

[0047] For the ADPCM data, for example, audio data recorded by representing the difference of 16-bit digital data with 4 bits is decoded by the decoder 82, supplied to the above SPU 71, processed by digital/analog conversion and the like in the SPU 71, and used to drive the speaker 73.

[0048] Also, for the PCM data, for example, audio data recorded as 16-bit digital data is decoded by the decoder 82 and used to drive the speaker 73.

[0049] Furthermore, the communication control unit 90 includes a communication control device 91 that controls communication with the CPU 51 via the bus BUS, a controller connection section 9 to which a controller 20 for inputting instructions from a user is connected, and memory card insertion sections 8A and 8B to which a memory card 10 or the portable electronic device 100 to be described later, serving as

an auxiliary storage device storing game setting data and the like, is connected, the memory card insertion sections 8A and 8B being provided in the communication control device 91.

[0050] The controller 20 connected to the above controller connection section 9 has, for example, 16 instruction keys for inputting instructions from a user, and according to instructions from the communication control device 91, the state of these instruction keys is transmitted to the communication control device 91 by synchronous communication approximately 60 times per second. The communication control device 91 then transmits the state of the instruction keys of the controller 20 to the CPU 51.

[0051] As a result, instructions from the user are input to the CPU 51, and the CPU 51 performs processing according to the instructions from the user based on the game program or the like being executed.

[0052] Here, it is necessary to transfer a large amount of image data at high speed between the main memory 53, the GPU 62, the image decoder 64, and the decoder 82 when reading programs, displaying images, or drawing. Therefore, in this video game device, as described above, so-called DMA transfer is performed in which data is directly transferred between the main memory 53, the GPU 62, the image decoder 64, and the decoder 82 under control from the peripheral device control unit 52 without passing through the CPU 51. This reduces the load on the CPU 51 due to data transfer and enables high-speed data transfer.

[0053] Also, when needing to store game setting data or the like being executed, the CPU 51 transmits the data to be stored to the communication control device 91, and the communication control device 91 writes the data from the CPU 51 into a memory card 10 or the portable electronic device 100 inserted in the slot of the memory card insertion section 8A or 8B.

[0054] Here, the communication control device 91 is provided with a protection circuit for preventing electrical destruction. The memory card 10 and the portable electronic device 100 are separated from the bus BUS, and can be attached and detached while the power of the device main body is turned on. Therefore, when the storage capacity of the memory card 10 or the portable electronic device 100 becomes insufficient, a new memory card can be inserted without turning off the power of the device main body. For this reason, game data that needs to be backed up is not lost, and a new memory card can be inserted and necessary data can be written to the new memory card.

[0055] Also, a parallel I/O interface (PIO) 96 and a serial I/O interface (SIO) 97 are interfaces for connecting the above memory card 10 or portable electronic device 100 and the video game device 1.

[0056] [Portable Electronic Device] Next, a portable electronic device that is an embodiment of the present invention will be described. Hereinafter, a case in which the portable electronic device 100 according to the present invention is inserted into the above-mentioned parent machine video game device 1 and used as a child machine will be described.

[0057] Specifically, the portable electronic device 100 serving as the child machine is inserted into the memory card insertion section 8 provided in the slot sections 7A and 7B of the parent machine video game device 1, and can be used as a unique memory card corresponding to the multiple connected operation devices 20. For example, when two users (game players) play a game, the conventional function is that each of the two portable electronic devices 100 records the respective game results and the like.

[0058] Note that when inserting the memory card 10 or the portable electronic device 100 into the memory card insertion section 8, the conductors of the power supply and ground (earth) connection terminals of the connector of the memory card 10 or the portable electronic device 100 are formed longer than other terminals so that the power supply and ground terminals are electrically connected first. This is to ensure

electrical operation safety and stability, and the connection conductors of the memory card insertion section 8 of the video game device 1 may be formed longer, or both may be formed longer. Also, to prevent erroneous insertion, the left and right shapes of the connector section are formed asymmetrically.

[0059] Figures 5 to 7 show the outer appearance of the portable electronic device 100 as an embodiment of the present invention; Figure 5 is a plan view of the portable electronic device 100, Figure 6 is a perspective view showing a state in which a lid member 110 for protecting the connector section is closed, and Figure 7 is a perspective view showing a state in which the lid member 110 is open.

[0060] As shown in Figures 5 to 7, the portable electronic device 100 according to the present invention is configured to have a housing 101, an operation section 120 having one or more operation members 121 and 122 for event input and various selections, a display section 130 consisting of a liquid crystal display device (LCD) or the like, and a window section 140 provided for wireless communication such as infrared wireless communication by wireless communication means to be described later.

[0061] The housing 101 consists of an upper shell 101a and a lower shell 101b and houses a substrate 151 on which memory elements and the like are mounted. This housing 101 can be inserted into the slot sections 7A and 7B of the main unit of the video game device 1, and a connector section 150 having a rectangular window is provided on the side surface of one end thereof.

[0062] The window section 140 is provided at the other end portion of the housing 101, which is formed in a substantially semi-circular shape. The display section 130 is provided on the upper surface of the housing 101, occupying approximately half of the upper surface area and located near the window section 140. The operation section 120 is provided on the upper surface of the housing 101, occupying approximately half of the upper surface area and located on the side opposite to the window section 140. The operation section 120 includes a lid member 110 formed in a substantially rectangular shape, rotatably supported relative to the housing 101 and having one or more operation members 121 and 122, and switch pressing sections 102 and 103 provided on the housing 101 at positions opened and closed by the lid member 110.

[0063] The operation members 121 and 122 are arranged so as to penetrate the lid member 110 from the upper surface side to the lower surface side of the lid member 110. These operation members 121 and 122 are supported by the lid member 110 and are movable in a direction to protrude from and retract into the upper surface portion of the lid member 110.

[0064] The switch pressing sections 102 and 103 have pressing members supported by the housing 101 and are movable in a direction in which they protrude from and retract into the upper surface portion of the housing 101. These pressing members, when pressed from above, press pressing switches such as diaphragm switches arranged on the substrate 151 inside the housing 101.

[0065] These switch pressing sections 102 and 103 are provided at positions corresponding to the positions of the respective operation members 121 and 122 when the lid member 110 is in a closed state. That is, when the lid member 110 is closed, pressing the operation members 121 and 122 from above in a direction in which same are retracted into the upper surface portion of the lid member 110 causes the operation members 121 and 122 to press the corresponding pressing switches inside the housing 101 via the pressing members of the corresponding switch pressing sections 102 and 103.

[0066] Inside the window of the connector section 150, as shown in Figure 8, power supply and signal terminals 152 are arranged on the substrate 151 and face outward.

[0067] The shape and dimensions of the connector section 150 are common to those of a normal memory card 10 used in the video game device 1.

[0068] Figure 9(a) is a block diagram showing an example of a configuration of a main part of the above portable electronic device.

[0069] The portable electronic device 100, like the above-mentioned normal memory card 10, includes a control means 41 for controlling the operation thereof, a connector 42 for connecting to a slot of an information device or the like, and a nonvolatile memory 46 as an element for storing data.

[0070] The control means 41 is configured using, for example, a microcomputer (abbreviated as microcomputer in the figures), and internally has a program memory section 41a serving as a program storage means. Also, as the nonvolatile memory 46, a semiconductor memory element such as a flash memory that retains recorded data even when the power is off (for example, 128 Kbytes) is used. Note that the portable electronic device 100 according to the present invention is configured to include a battery 49 to be described later, so a static random access memory (SRAM) capable of high-speed data input and output may also be used as the nonvolatile memory 46.

[0071] In addition to the above configuration, the portable electronic device 100 includes an operation (event) input means 43 such as operation buttons for operating the stored programs, a display means 44 such as a monochrome liquid crystal display device (LCD) of 32×32 dots or the like for displaying various information according to the program, a wireless communication means 48 for transmitting and receiving data with other memory cards or the like by infrared or the like, and a battery 49 that supplies power to the above components.

[0072] Also, the portable electronic device 100 incorporates a small battery 49 as a power supply means. Therefore, the portable electronic device 100 can operate independently even when removed from the slots 7A and 7B of the parent machine video game device 1.

[0073] Note that the battery 49 may be a rechargeable secondary battery. When the child machine portable electronic device 100 is inserted into the slots 7A and 7B of the parent machine video game device 1, power is supplied from the parent machine video game device 1. That is, the power terminal 50 of the battery 49 is connected via a reverse current prevention diode 51, so that when inserted into the slot of the parent machine such as the video game device 1, power is supplied from the parent machine to the child machine side, and if a secondary battery is used, charging of the secondary battery is also performed.

[0074] The portable electronic device 100 further includes a clock 45 and a speaker 47 serving as a sound generation means that generates sound according to the program. All of the above components are connected to the control means 41 and operate under control of the control means 41.

[0075] Figure 9(b) shows control items of the control means 41. While a normal memory card 10 only includes a main unit connection interface to the information device and a memory interface for inputting and outputting data to and from the memory, the portable electronic device 100 of this embodiment includes, in addition to the above interfaces, a display interface, an operation input interface, a sound interface, a wireless communication interface, clock management, and a program download interface.

[0076] Thus, the portable electronic device 100 includes control means (microcomputer) 41 provided with interfaces (drivers) for managing the functions added by this embodiment, independently of the conventional functions of the main unit (parent machine) connection interface and nonvolatile memory management, thereby maintaining compatibility with conventional functions.

[0077] Also, the portable electronic device 100 is configured to include input means 43 such as button switches for operating the executed program and display means 44 using a liquid crystal display device (LCD) or the like, so as to be usable as a portable game device when a game application is operated.

[0078] Moreover, the portable electronic device 100 has a function of storing application programs downloaded from the main unit of the video game device 1 into the program memory section 41a of the microcomputer 41, so that application programs and various driver software operating on the portable electronic device 100 can be easily changed.

[0079] As described above, the portable electronic device 100 according to the present invention can control operation independently of the video game device 1. Therefore, data created by applications stored in the program memory section 41a serving as program storage means on the portable electronic device 100 side can be created independently of the application software on the video game device 1 side. Also, by exchanging this data with the video game device 1, cooperative operation (link) between the portable electronic device 100 and the video game device 1 becomes possible.

[0080] Furthermore, since the portable electronic device 100 is provided with a clock 45, it is also possible to share time data with the video game device 1 side. That is, not only can the respective time data be matched, but data for controlling the progress of games independently executed by each according to real time can also be shared.

[0081] Figure 10 schematically shows a state in which wireless communication is performed between portable electronic devices 100 according to the present invention. Thus, the portable electronic device 100 can exchange internal data between multiple memory cards by transmitting and receiving data via the window section 140 serving as a wireless communication window for wireless communication by infrared or the like in the wireless communication means 48. Note that the above internal data includes, for example, data transferred from the information device side such as a video game device and stored in the storage means inside the memory card.

[0082] Note that in the above embodiment, the portable electronic device 100 has been described as being used as an auxiliary storage device of a video game device, but target applications are not limited to video game devices and can of course be applied to various information searches and the like.

[0083] As described above, the portable electronic device 100 can share with the main unit of the video game device 1 game data generated by the microcomputer 41 serving as the control means, time data obtained by the clock 45 inside the memory card, data generated by other memory cards obtained via the wireless communication means 48, and the like.

[0084] Figure 11 schematically shows a state in which cooperative operation is performed between the parent machine video game device 1 and the child machine portable electronic device 100.

[0085] The parent machine video game device 1 is provided with an optical disk (CD-ROM) which is a recording medium on which application software programs are recorded, and the program read therefrom is downloaded to the child machine portable electronic device 100 inserted into the slot sections 7A and 7B of the main unit of the video game device 1.

[0086] Figure 12 shows a data flow in a case in which a video game application program supplied from an optical disk (CD-ROM) mounted in the disk mounting section 3 of the parent machine video game device 1 is directly transferred (downloaded) to the program memory section 41a serving as the program storage

means inside the microcomputer 41 serving as the control means of the child machine portable electronic device 100 via the CPU 9 serving as the control means of the video game device 1.

[0087] Figure 13 shows the procedure of the download in Figure 12.

[0088] In step ST1, first, the video game application program operating on the microcomputer inside the child machine portable electronic device 100 (hereinafter simply referred to as the child machine) is read as data from the CD-ROM mounted in the disk mounting section 3 of the video game device 1 serving as the parent machine (hereinafter simply referred to as the parent machine). Note that, as described above, this application program is generally different from the one operating on the parent machine video game device 1.

[0089] Next, in step ST2, the CPU 9 serving as the control means of the parent machine issues a "program download request command" to the microcomputer 41 serving as the control means of the child machine portable electronic device 100. The CPU 9 then polls to receive a "program download permission status" from the microcomputer 41. Note that polling here means a method of inquiring about the presence or absence of a service request and providing the service.

[0090] In step ST3, the microcomputer 41 on the child machine portable electronic device 100 side receives the "program download request command" from the CPU 9 of the parent machine.

[0091] Then, in step ST4, upon finishing the currently processing routine and becoming ready to execute the program download, the microcomputer 41 on the child machine side returns a "program download permission status" to the CPU 9 of the parent machine. Next, in step ST5, when the CPU 9 of the parent machine receives the "program download permission status" from the microcomputer 41 on the child machine side, the program read from the CD-ROM or the like in step ST1 is transferred (downloaded) and written into the program memory section 41a serving as the program storage means of the portable electronic device 100. Then, the CPU 9 polls to receive a "program start permission status" from the microcomputer 41.

[0092] At this time, the address of the program memory section 41a into which the downloaded data is written is managed by the microcomputer 41. Moreover, a case in which the program downloaded from the parent machine is stored in the program memory section 41a inside the microcomputer 41 is illustrated in the above description, but the program may be stored in a storage element such as SRAM capable of high-speed data input and output.

[0093] In step ST6, the microcomputer 41 of the memory card receives the program transferred from the parent machine as data and writes same into the program memory section 41a. At this time, from the CPU 9 of the parent machine, it appears as if the program data is directly written into the program memory section 41a of the child machine portable electronic device 100. Also, as described above, the address of the program memory section 41a is managed by the microcomputer 41.

[0094] Then, in step ST7, upon receiving the final program data from the parent machine and becoming ready to execute same, the microcomputer 41 of the child machine portable electronic device 100 returns a "program start permission status" to the CPU 9 of the main unit. In step ST8, the CPU 9 of the parent machine receives the "program start permission status" from the microcomputer 41 of the portable electronic device 100 and issues a "program start command."

[0095] Then, upon receiving the "program start command" from the CPU 9 of the parent machine, the microcomputer 41 of the portable electronic device 100 operates the program from a predetermined address.

[0096] By means of the above procedure, the application program is directly transferred (downloaded) from the parent machine video game device 1 to the program memory section 41a inside the microcomputer 41 of the child machine portable electronic device 100 inserted therein.

[0097] Note that, as described above, the means for supplying the application program is not limited to a recording medium such as an optical disk, and may be supplied via a communication line. In that case, only step ST1 in the above procedure differs.

[0098] Meanwhile, the above download procedure describes a download procedure in a case in which the application program is directly downloaded from the parent machine video game device 1 to the program memory section 41a inside the microcomputer 41 serving as the control means of the child machine portable electronic device 100 inserted therein.

[0099] On the other hand, there are also cases in which the CPU 9 of the parent machine downloads the application program data to the nonvolatile memory 46 inside the child machine portable electronic device 100, and then copies and executes the data in the program memory section 41a inside the microcomputer 41.

[0100] Figure 14 shows the data flow in such a case. Specifically, the video game application program supplied from an optical disk or the like mounted in the disk mounting section 3 of the parent machine video game device 1 is transferred (downloaded) to the nonvolatile memory 46 inside the child machine portable electronic device 100 via the CPU 9 serving as the control means of the video game device 1, and then copied and executed in the program memory section 41a inside the microcomputer 41 serving as the control means.

[0101] Figure 15 shows the procedure of the above download.

[0102] In step ST11, first, the video game application program operating on the microcomputer inside the child machine portable electronic device 100 is read as data from the CD-ROM mounted in the disk mounting section 3 of the parent machine video game device 1.

[0103] Then, in step ST12, the CPU 9 serving as the control means of the parent machine transfers (downloads) the program data read from the CD-ROM to the nonvolatile memory 46 of the child machine portable electronic device 100. This procedure is the same as when backing up data in a conventional video game device.

[0104] Next, in step ST13, the microcomputer 41 serving as the control means of the portable electronic device 100 receives the application program transferred from the CPU 9 of the parent machine as data and writes same into the nonvolatile memory 46 in a procedure similar to conventional data backup.

[0105] Next, in step ST14, upon receiving a "program start request command" from the CPU 9 of the parent machine, the microcomputer 41 of the portable electronic device 100 copies data of the specified size from the address indicated by the above command in the nonvolatile memory 46 to the program memory section 41a inside the microcomputer 41.

[0106] The microcomputer 41 of the portable electronic device 100 then executes the program copied to the program memory section 41a from the start address.

[0107] By means of the above procedure, the application software program is transferred (downloaded) as data from the parent machine video game device 1 to the program memory section 41a inside the microcomputer 41 of the child machine portable electronic device 100 via the nonvolatile memory 46.

[0108] Note that the application program downloaded from the parent machine video game device 1 to the child machine portable electronic device 100 is generally different from the one operating on the parent machine video game device 1. Naturally, the downloaded application program may operate on both the video game device 1 and the portable electronic device 100. However, in this case, there is the constraint that the CPU on the video game device 1 side and the microcomputer on the portable electronic device 100 side be the same processor.

[0109] Next, cooperative operation performed by independently executing the application software program downloaded from the parent machine video game device 1 on the child machine portable electronic device 100 and exchanging the execution results again with the video game device 1 will be described.

[0110] Here, attribute data of characters or persons appearing in so-called role-playing games or the like operating on the parent machine video game device 1 is downloaded to the child machine portable electronic device 100. Note that the above attribute data is data representing growth level, personality, and the like.

[0111] Then, by training the characters or persons on the program executed by the microcomputer 41 inside the child machine portable electronic device 100, those attributes are changed independently of the program executed on the main unit of the parent machine video game device 1.

[0112] The portable electronic device 100 according to the embodiment of the present invention is configured to operate independently and is small and convenient to carry. Therefore, a user (game player) can always carry around and train the characters or persons appearing in the program executed on the portable electronic device 100. Also, the user can transfer (upload) the attributes of the characters or persons trained from the portable electronic device 100 to the main unit of the video game device 1. In this case, the characters or persons whose attributes have changed can be incorporated into and operated by the program executed on the parent machine video game device 1.

[0113] As described above, by sharing and mutually changing attribute data of characters or the like in the parent machine video game device 1 and the child machine portable electronic device 100, a video game capable of cooperative operation can be configured.

[0114] As described above, the inventors have described the use of the child machine portable electronic device 100 as cooperative operation performed while exchanging data with the parent machine video game device 1, and the use as a video game device independently executing application software downloaded from the parent machine video game device 1 on the child machine portable electronic device 100. Here, the inventors newly propose a mode of using the child machine portable electronic device 100 as an electronic device other than a video game device. Generally, game software is stored on optical disks such as CD-ROMs and sold separately from hardware such as parent machines and child machines. The inventors have focused on providing convenience programs such as a calculator program and a remote control program additionally recorded in free storage areas of CD-ROMs storing specific game software.

[0115] Here, an example of distributing calculator program data on a CD-ROM and using the program by transferring same from the parent machine to the child machine will be described.

[0116] A CD-ROM or the like storing calculator program data, menu screen data, remote control program data, and the like is distributed, the parent machine reads this, and the user transfers the calculator program data to the child machine. The child machine saves this calculator program.

[0117] First, a series of processes on the parent machine side will be described with reference to the flowchart shown in Figure 16.

[0118] In an arbitrary free area of the CD-ROM 3 storing game software, a database of menu data, calculator program data, remote control data, and the like is stored.

[0119] In the first step S441, the CD-ROM is mounted and driven on the parent machine, in step S442 the database is read, and in step S443 the menu data is displayed as a menu screen on a television receiver. Figure 17 shows a state of such processing on the parent machine side. The CD-ROM 3 mounted on the parent machine 1 stores download data, menu data, calculator program data, remote control program data, and the like. When this is driven on the parent machine 1 and the database is read, a menu screen 200 is displayed on the television receiver connected to the parent machine. Then, the process proceeds to the next step S444.

[0120] In step S444, branching occurs depending on whether or not the calculator displayed in step S443 is selected. That is, the user moves the cursor to "1. Calculator" by operating the first operation section 21 (four buttons for up, down, left, and right) of the operation device 200 while looking at the menu screen 200 on the television receiver (see Figure 1). Note that, in addition to identification by the cursor, the display of the target program can be made different in color or reversed by operating the first operation section 21 of the operation device 200.

[0121] When the calculator is selected in this way, the process proceeds to step S445 as "YES," and when the calculator is not selected, the process proceeds to the corresponding program of the selected menu as "NO."

[0122] In step S445, the appearance of the calculator is preview-displayed for visual effect. Then, the process proceeds to step S446.

[0123] In step S446, branching occurs depending on whether or not the selection of the calculator is decided. That is, when the selection of the calculator is decided, the process proceeds to step S447 as "YES," and when not decided, the process returns to step S443 as "NO." This decision is executed by operating the second operation section 22 of the operation device 200. Figure 18 shows a state of such decision of the calculator program. Here, a substantially rectangular program display window 231 is opened on the left side of the display screen 200, and a substantially rectangular preview window 233 is opened on the left side of the display screen 200.

[0124] The program displayed in the program display window 231 is a program stored in the CD-ROM 3. The program displayed in the program display window 231 can be selected and subjected to a predetermined operation such as recording. The selected program is displayed in reverse video 232.

[0125] In the preview window 233, when the calculator program is selected, a preview image of the calculator's appearance is displayed to indicate to the user that the calculator has been selected.

[0126] Returning to Figure 16, in step S447, the selected calculator program data is transferred to the child machine, and the process proceeds to the next step S448.

[0127] In step S448, branching occurs depending on whether or not to end this series of processes. If "end" is selected, the series of processes ends as "YES," and if "end" is not selected, the process returns to step S443 as "NO."

[0128] Next, a series of processes on the child machine side will be described with reference to the flowchart shown in Figure 19.

[0129] In the first step S451, branching occurs depending on whether or not the child machine is connected to the parent machine. That is, if connected to the parent machine, the process proceeds to step S452 as "YES," and if not connected, the process returns to step S451 as "NO."

[0130] In step S452, the calculator program data is saved according to instructions from the parent machine. Then, this series of processes ends.

[0131] As described above, calculator program data is distributed on a CD-ROM, the parent machine reads this, and the user selects the calculator on the screen and transfers the data to the child machine.

[0132] Next, the calculator program transferred to the child machine and the use thereof will be described.

[0133] Before describing the calculator using this child machine, the functions of generally commercially available calculators will be described. This is because the calculator using this child machine enables the same functions as such commercially available calculators by means of a program downloaded from the CD-ROM via the parent machine.

[0134] Various commercially available calculators exist, and although there are some differences in key display and key operation depending on the manufacturer, the calculator described in this embodiment is one of the most basic types.

[0135] The calculator has number-specifying keys consisting of ten numeric keys "0" to "9" and a decimal point key ".", i.e., a numeric keypad for entering numbers necessary for calculation. Also, function keys (or operation keys) include "+" (addition), "-" (subtraction), "×" (multiplication), "÷" (division), and "=" keys necessary for addition, subtraction, multiplication, and division.

[0136] In the calculator, entering a number, then pressing an operation key, and then entering another number is called an operation. Next, pressing the equal key "=" displays the calculation result. The calculator's operation is usually based on a calculation formula method executed by the operation key before the number entry. For example, the operation "2+3" is understood as two sets of "+2" and "+3," and the "+" before "2" is considered omitted.

[0137] A general calculator that executes such operations basically has, as shown in Figure 20, a power supply device 301, a register (number entry register) 302 that temporarily stores entered operands, an arithmetic device 303, and a display device 304 consisting of an LCD that displays numbers. Inputs from number-specifying keys 305 and operation keys 306 are operated by a human hand.

[0138] The register 302 temporarily stores numerical values such as input operands, operators, and calculation results. The arithmetic device 303 consists of a calculation circuit and executes addition, subtraction, multiplication, and division based on the operation of the operation keys 306 using the operands and operators from the register 302. The calculation result is displayed on the display device 304 via the register 302.

[0139] A brief explanation of the concept of four arithmetic operations of the arithmetic device 303 is as follows. Addition corresponding to the operation key "+" is performed by entering the addend into an accumulator and adding the value in the addition register to same. The result remains in the accumulator. Addition is performed by a full adder, which consists of two half adders.

[0140] Subtraction corresponding to the operation key "-" is performed by either adding a complement or using a subtractor. Multiplication corresponding to the operation key "×" is executed as repeated single-digit multiplication, shifting, and addition. Division corresponding to the operation key "÷" is repeated

addition, subtraction, shifting, and determination. Programming such four arithmetic operation functions possessed by general calculators is already known.

[0141] As described in relation to Figure 9, the child machine is configured with a microcomputer and has control means 41 having a program memory 41a inside and a nonvolatile memory 46. The program memory 41a incorporates an operating system that controls the operation of this child machine.

[0142] The calculator program downloaded from the parent machine to the nonvolatile memory 46 is executed by the microcomputer under control of the operating system, performing the above four arithmetic operations. One feature of this calculator program is that, regarding the number graphics from 0 to 9, in addition to the usual black display on a white background, inverted graphics with white display on a black background are prepared.

[0143] Next, with reference to Figure 22 and using Figure 21, the procedure for using a calculator using the child machine according to the present embodiment will be described. In step S461, an operand input operation using the number-specifying keys is performed. Figure 22 shows this situation. The screen displayed on the liquid crystal display section 44 of the child machine 100 is shown, and the number-specifying keys 305 and operation keys 306 are displayed on the display screen. The number-specifying key operation is performed by operating a plurality of operation members 121 (four in the figure) of the child machine to move the cursor 307 up, down, left, and right to align with the desired number-specifying key, and pressing the operation member 122 to determine the number-specifying key. This operation is repeated multiple times to input a number-specifying key of the desired number of digits. The input operand is displayed in the calculation result and other display area 309 in white characters on a black background (display inverted graphics). In step S462, a function key (operation key) operation is performed. The operation procedure of the operation key is the same as the above number-specifying key operation.

[0144] In step S463, a number-specifying key operation for inputting an operand is performed. The operation procedure of the number-specifying key for this operand is the same as the above number-specifying key operation for the operand. The input operand is displayed in the calculation result display area in inverted graphics. At this time, the calculation result up to this point is stored in a register.

[0145] In step S465, it is determined whether the equal function key has been pressed. If NO, the calculation result stored in the register 302 is used as the operand, and the function key operation of step S462 continues. If the equal function key has been pressed, the calculation result stored in the register 302 is sent to the control means 41. The control means 41 displays the calculation result in inverted graphics in the calculation result and other display area 309 of the liquid crystal display device 44 based on the calculation result.

[0146] The display of inverted graphics is performed by reading inverted graphic data in the calculator program downloaded in the nonvolatile memory 46 into the program memory 41a, and by inverting each dot of the liquid crystal display device by a video memory (VRAM) that controls the liquid crystal display device. As shown in Figure 22, by displaying the number-specifying keys 305 in black characters on a white background and displaying only the calculation result 309 in white characters on a black background, even when the operands, the operators, and the calculation results are sequentially displayed on the relatively small display device of the child machine, clear distinction from other number-specifying keys and the like can be made.

[0147] Next, another feature concerning the calculator using this child machine will be described. Generally, such portable electronic devices are required to be small in size. Therefore, the liquid crystal display device 44 arranged in a part thereof naturally also has a very small size. In such a very small liquid crystal display device, displaying the number-specifying keys, operation keys, and the like necessary for a calculator at a size that can be identified at a glance may be difficult.

[0148] For example, suppose the liquid crystal display device has 32×32 dots, and 8×8 dots are used for one character of the number-specifying keys and operation keys. In this case, the number of characters that can be displayed on one screen of the display device is 4×4 characters. However, even for a basic calculator, it is necessary to display a total of 20 characters, including 10 characters from "0" to "9" as number-specifying keys, 6 characters of operation keys including "=", ".", and the four arithmetic operations, and 4 characters sequentially displaying the calculation result and the like. Furthermore, if necessary, it is required to provide memory keys "M+", "M-", memory recall key "MR", and operation keys "%", " $\sqrt{\quad}$ ".

[0149] Therefore, in the display device of the child machine according to the present embodiment, the display screen is configured to be shiftable or scrollable. For example, as shown in Figure 23, during calculation, the screen is scrolled downward to display only the number-specifying keys 305 and operation keys 306, and the display area 308 for the calculation result and the like is removed from the screen.

[0150] Next, as shown in Figure 24, when displaying the calculation result, the screen is scrolled upward to bring the display area 308 for the calculation result and the like onto the screen. This scroll operation is performed using the four operation members 121 of the child machine. Such screen scrolling or screen shifting can be performed by various methods. For example, it can be performed by utilizing a shift register possessed by the microcomputer of the control means 41 of the child machine.

[0151] Also, the screen shift (scroll) is not limited to the vertical direction. When the number-specifying keys and operation keys increase, or when it is desired to display one character larger, the screen may be shifted in the horizontal direction. To enable such horizontal screen shifting, a memory area corresponding to the calculator operation panel corresponding to the number-specifying keys, operation keys, and calculation result area is secured in advance in the calculator program to be downloaded, a part thereof is set as the display area, and the display area is made movable by the operation members.

[0152]

[Effect of the Invention] According to the portable electronic device of the present invention, in addition to the function of a conventional memory card device used as an auxiliary storage device for an information device or the like, an operation input means for operating a stored program, a display means for displaying various types of information according to the above program, a wireless communication means for transmitting and receiving data with other memory cards or the like, and a battery or the like for supplying power to each of the above parts are provided, so that a memory card device can be provided, which is capable of not only storing data but of independently executing a downloaded application program. The present invention can provide technology for using a portable electronic device that can be connected to a parent machine and can also be used independently as a child machine as a calculator.

[BRIEF DESCRIPTION OF THE DRAWINGS]

Figure 1 is a plan view showing the outer appearance of a video game device serving as a parent machine in which a portable electronic device according to an embodiment of the present invention is used as a child machine.

Figure 2 is a rear view showing a state of the slot section of the video game device serving as the parent machine.

Figure 3 is a perspective view showing the appearance of the video game device serving as the parent machine.

Figure 4 is a block diagram showing a specific configuration example of a main part of the video game device serving as the parent machine.

Figure 5 is a plan view showing the appearance of an embodiment of the portable electronic device according to the present invention.

Figure 6 is a perspective view showing the appearance of an embodiment of the portable electronic device according to the present invention.

Figure 7 is a perspective view showing an embodiment of the portable electronic device according to the present invention with the lid member opened.

Figure 8 is a front view showing the appearance of an embodiment of the portable electronic device according to the present invention.

Figure 9 is a block diagram showing a configuration example of a main part of an embodiment of the portable electronic device according to the present invention.

Figure 10 is a diagram for explaining a wireless communication function of an embodiment of the portable electronic device according to the present invention.

Figure 11 is a diagram for explaining cooperative operation between a child machine which is an embodiment of the portable electronic device according to the present invention and a parent machine which is a video game device main unit.

Figure 12 is a diagram showing a data flow of program data downloaded from the video game device main unit (parent machine) to the portable electronic device (child machine).

Figure 13 is a flowchart showing the download procedure of Figure 12.

Figure 14 is a diagram showing another data flow of program data downloaded from the video game device main unit (parent machine) to the portable electronic device (child machine).

Figure 15 is a flowchart showing the download procedure of Figure 14.

Figure 16 is a flowchart showing a processing procedure on the parent machine side when downloading a calculator program.

Figure 17 is a diagram explaining a state when downloading a calculator program.

Figure 18 is a diagram showing a menu screen when downloading a calculator program.

Figure 19 is a flowchart showing a processing procedure on the child machine side when downloading a calculator program.

Figure 20 is a flowchart showing a processing procedure on the parent machine side when downloading a calculator program.

Figure 21 is a flowchart showing an outline of the calculator program.

Figure 22 is a diagram showing the display device of the child machine and display content.

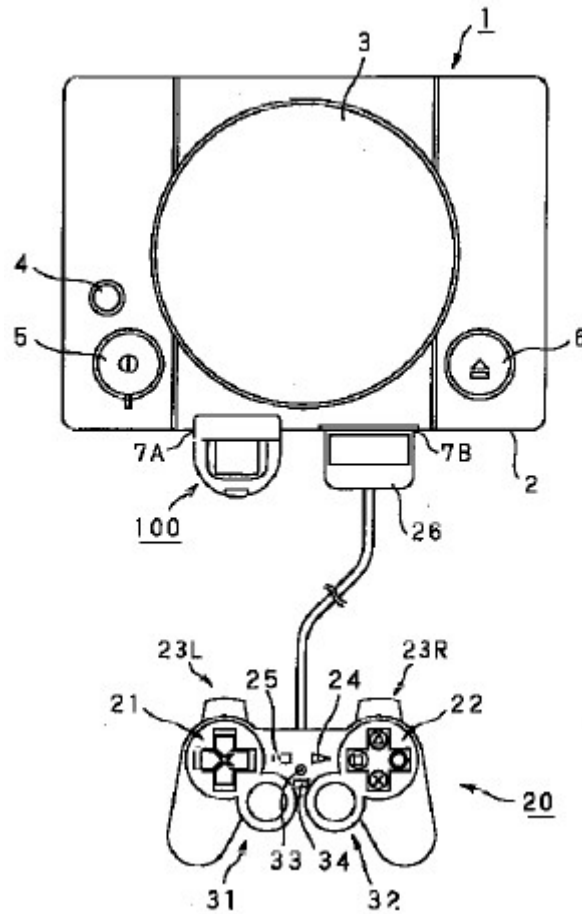
Figure 23 is a diagram explaining a scrolling state of the display content of the child machine's display device.

Figure 24 is a diagram explaining a scrolling state of the display content of the child machine's display device.

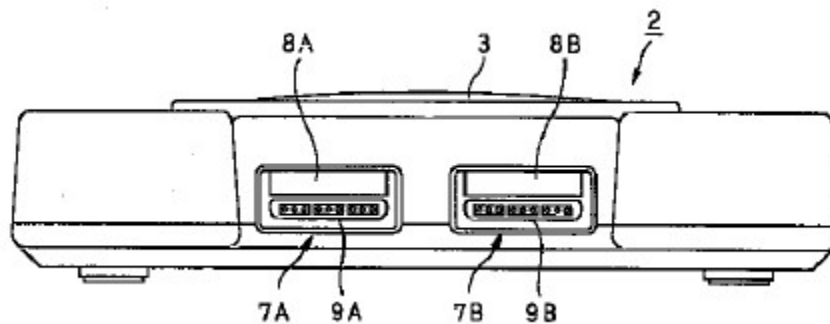
Figure 25 is a diagram showing a configuration example of a main part of a normal memory card device.
Figure 26 is a diagram showing an example of a video game device using a memory card as an auxiliary storage device.

[Description of Reference Numerals]

10 memory card, 41 control means, 42 connection connector, 43 button switch, 44 display screen, 45 clock, 46 nonvolatile memory, 47 speaker, 48 wireless communication means, 49 battery

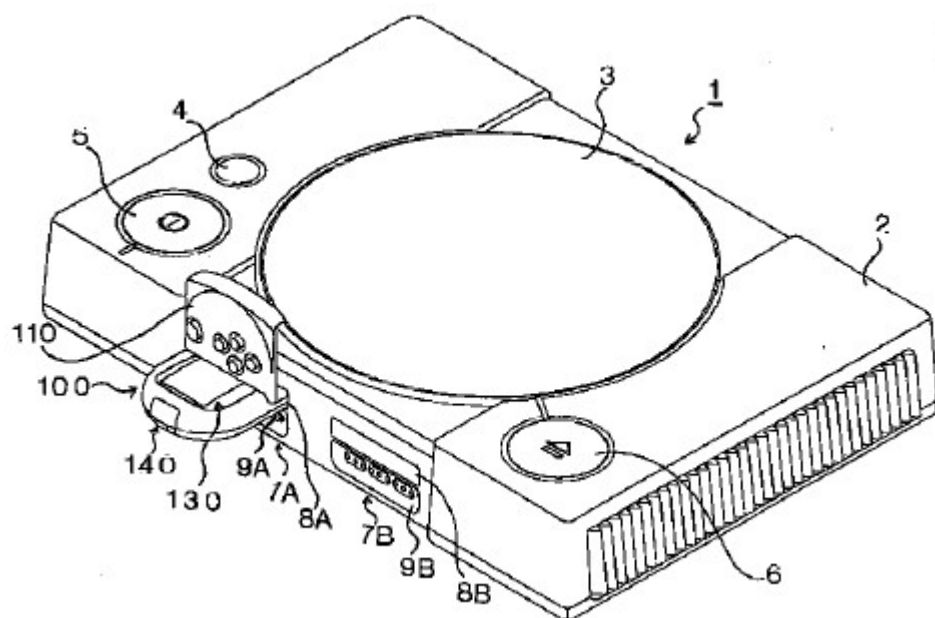


[FIGURE 1]

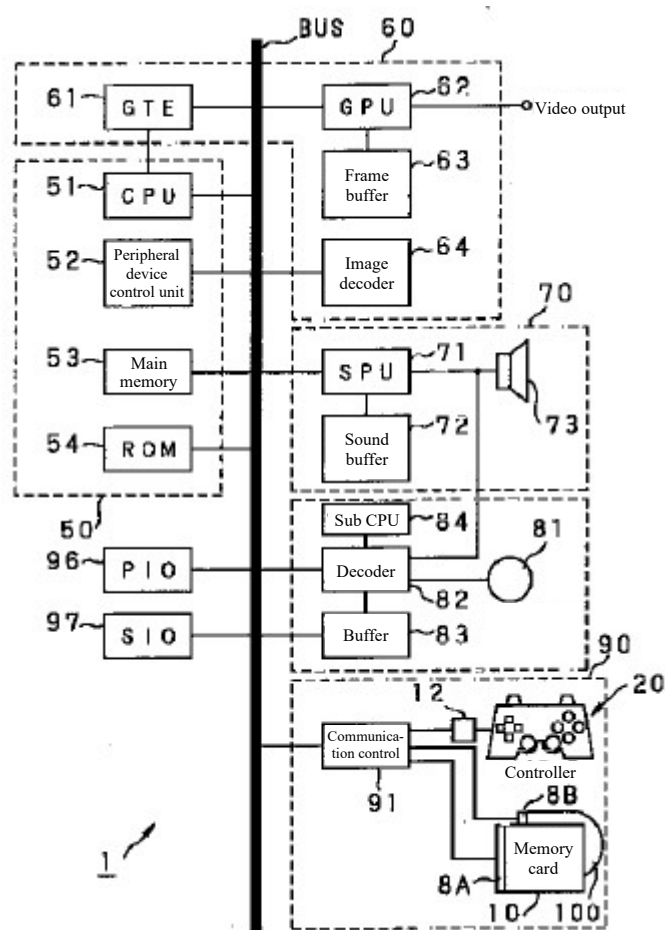


[FIGURE 2]

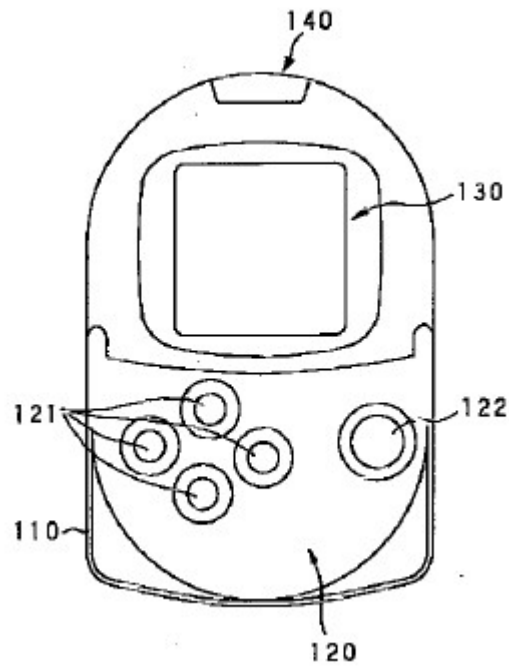
(21) Patent Application No. 2000-148694 (P2000-148694A)



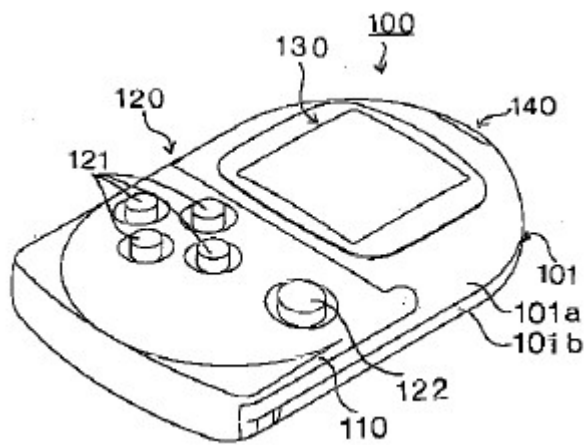
[FIGURE 3]



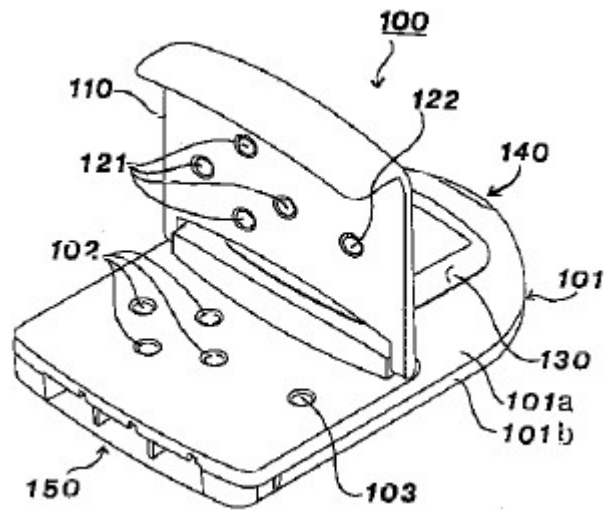
[FIGURE 4]



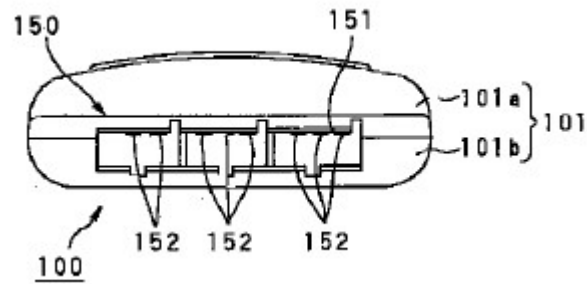
[FIGURE 5]



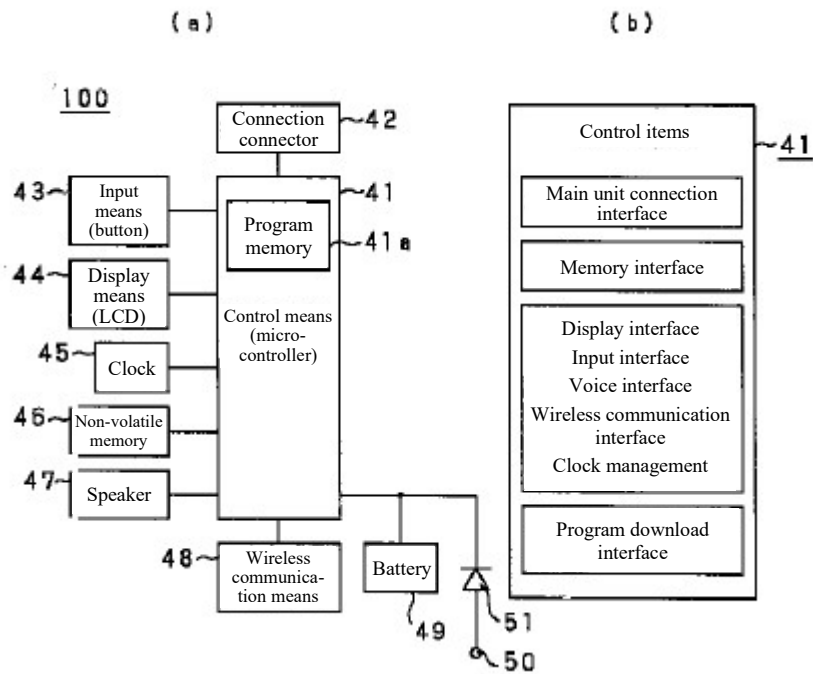
[FIGURE 6]



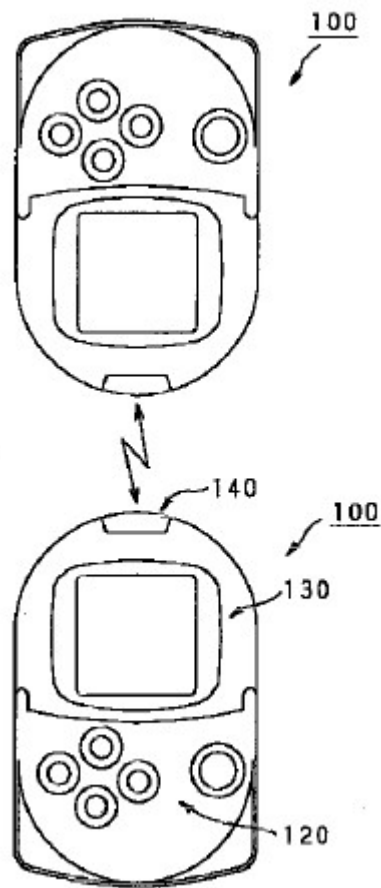
[FIGURE 7]



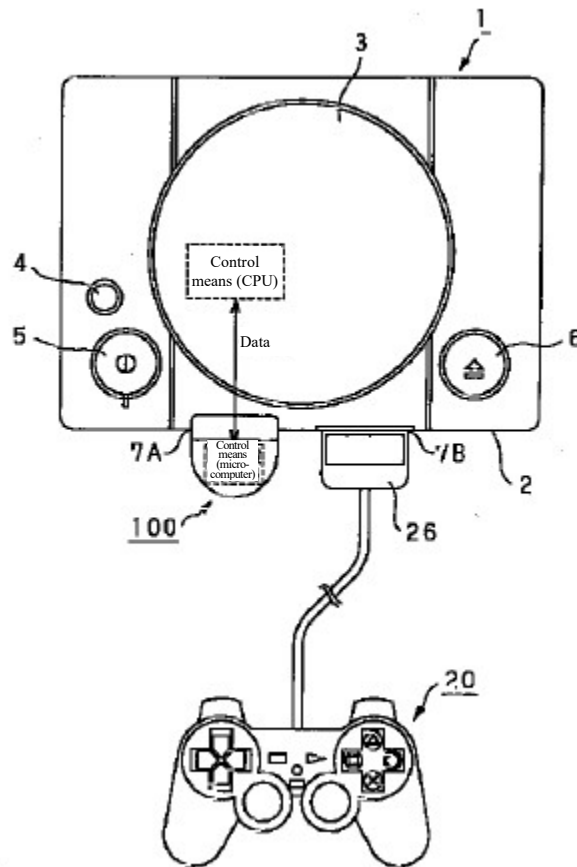
[FIGURE 8]



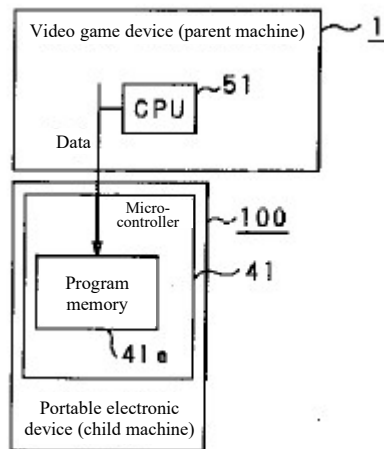
[FIGURE 9]



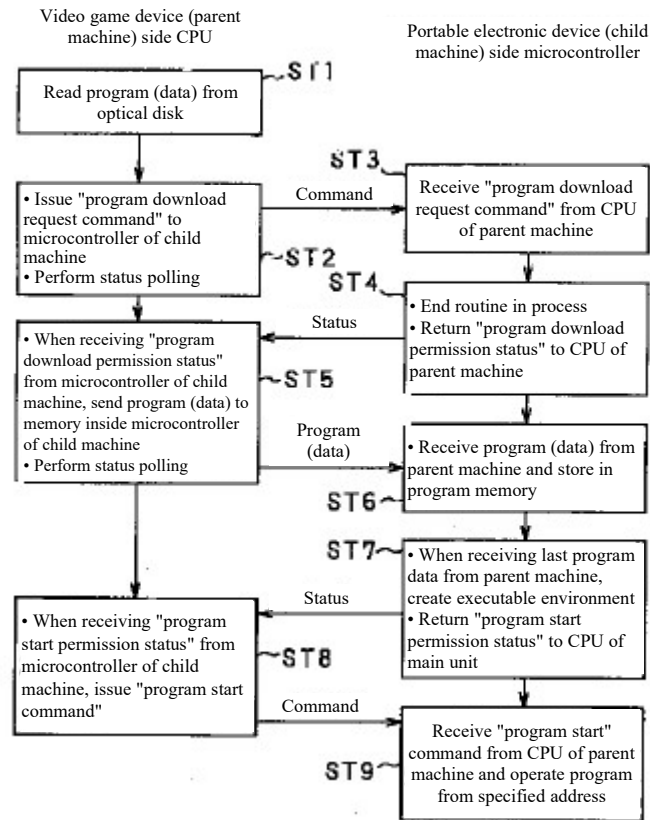
[FIGURE 10]



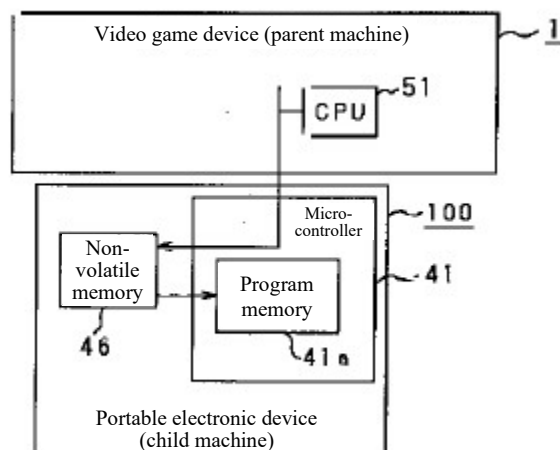
[FIGURE 11]



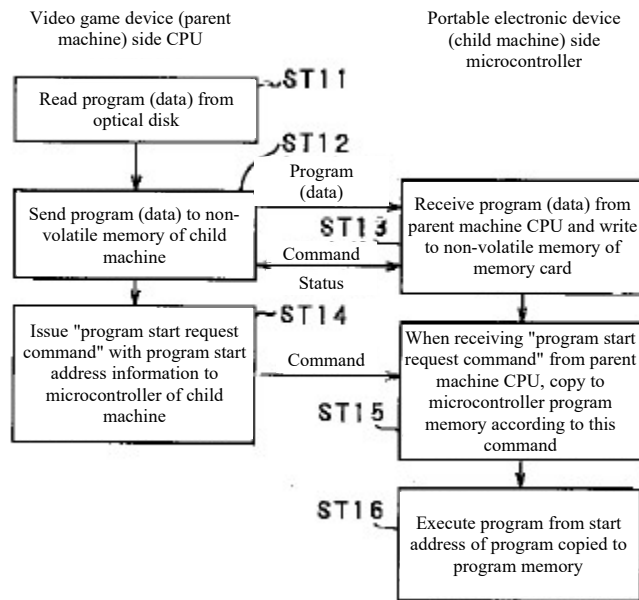
[FIGURE 12]



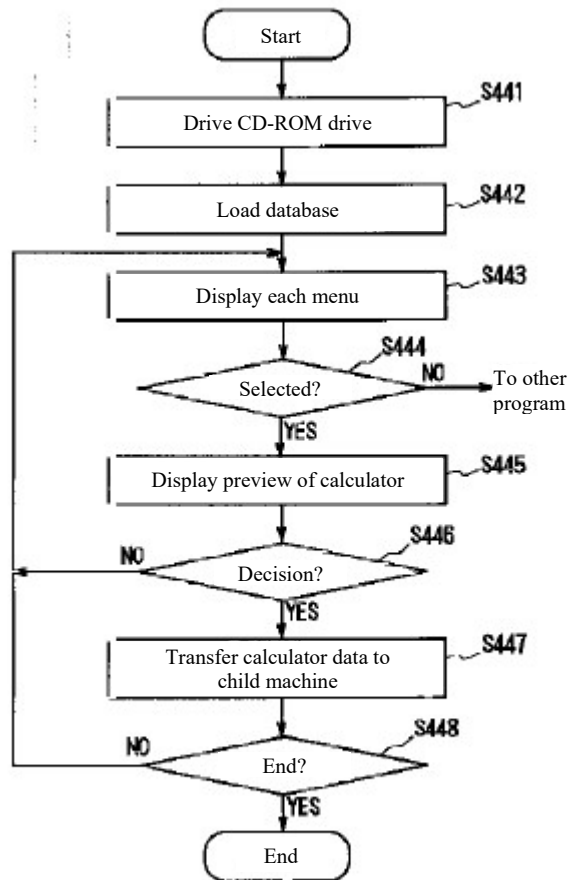
[FIGURE 13]



[FIGURE 14]

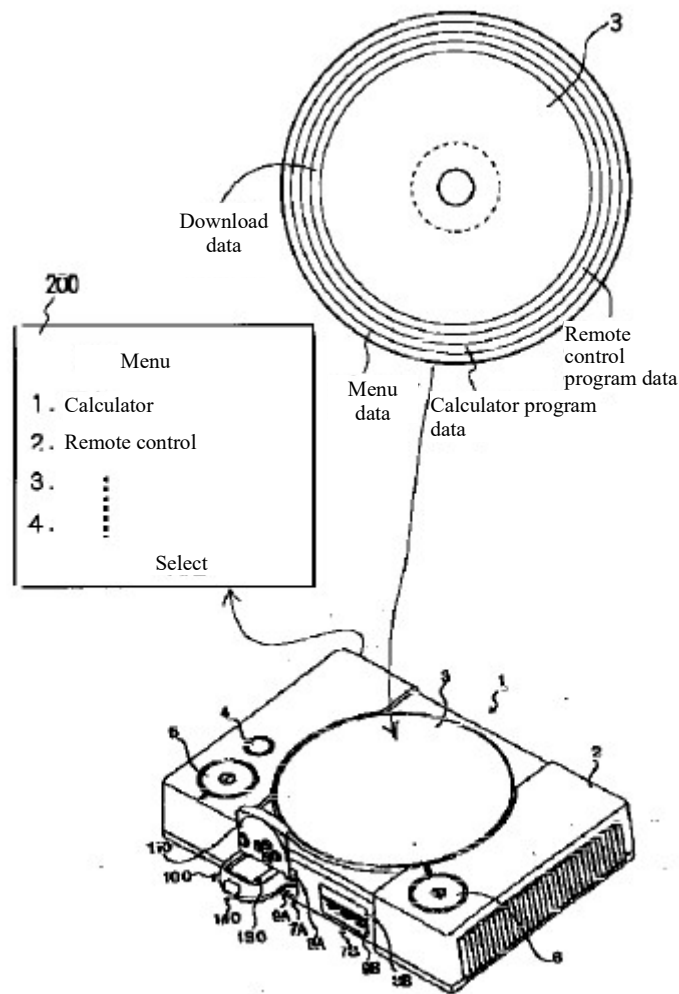


[FIGURE 15]

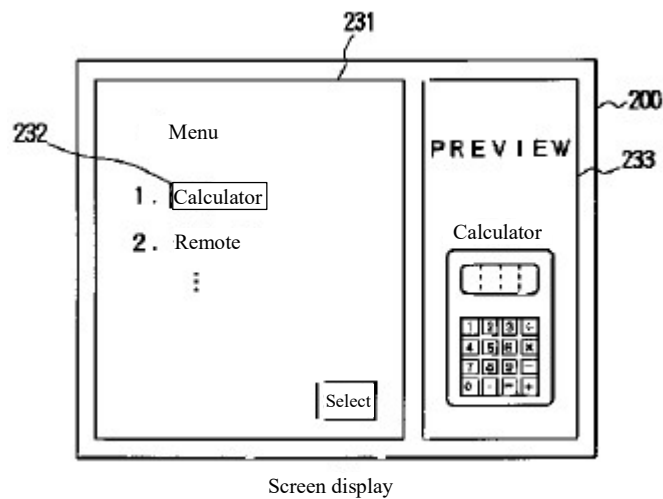


Processing on parent machine side

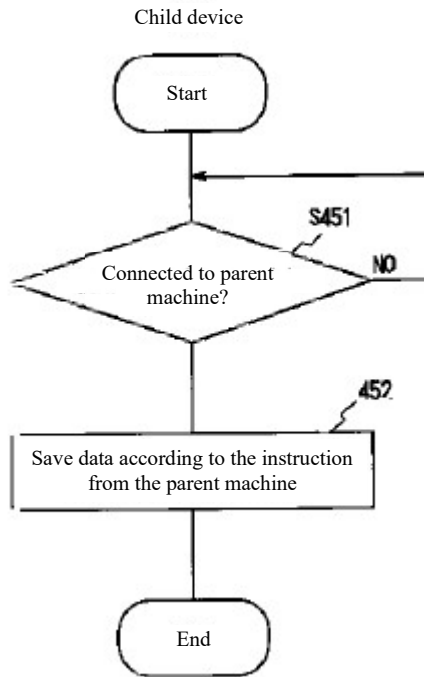
[FIGURE 16]



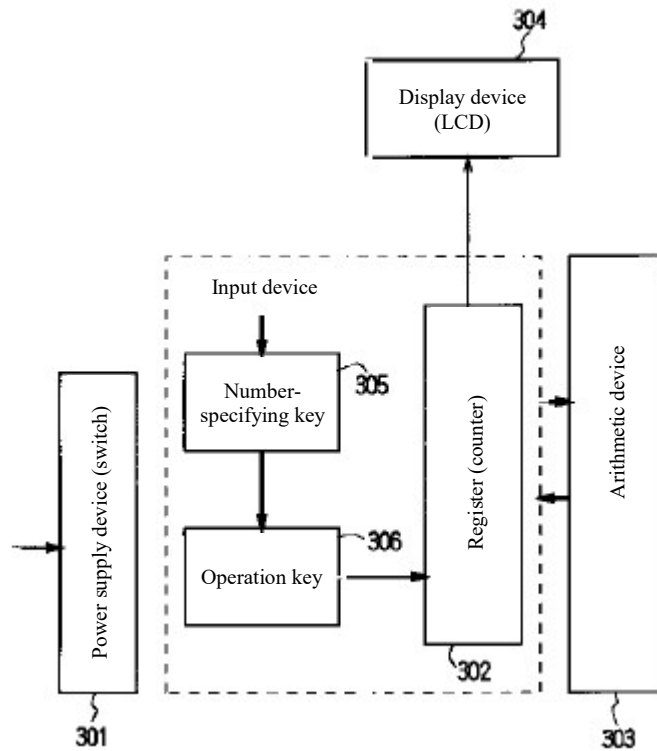
[FIGURE 17]



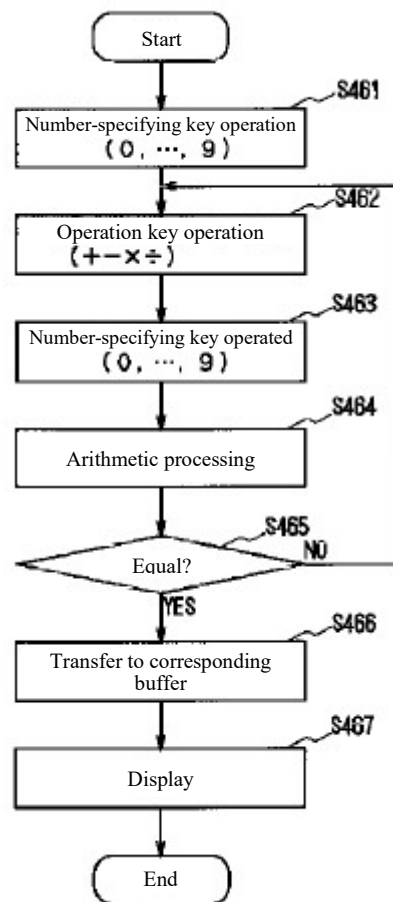
[FIGURE 18]



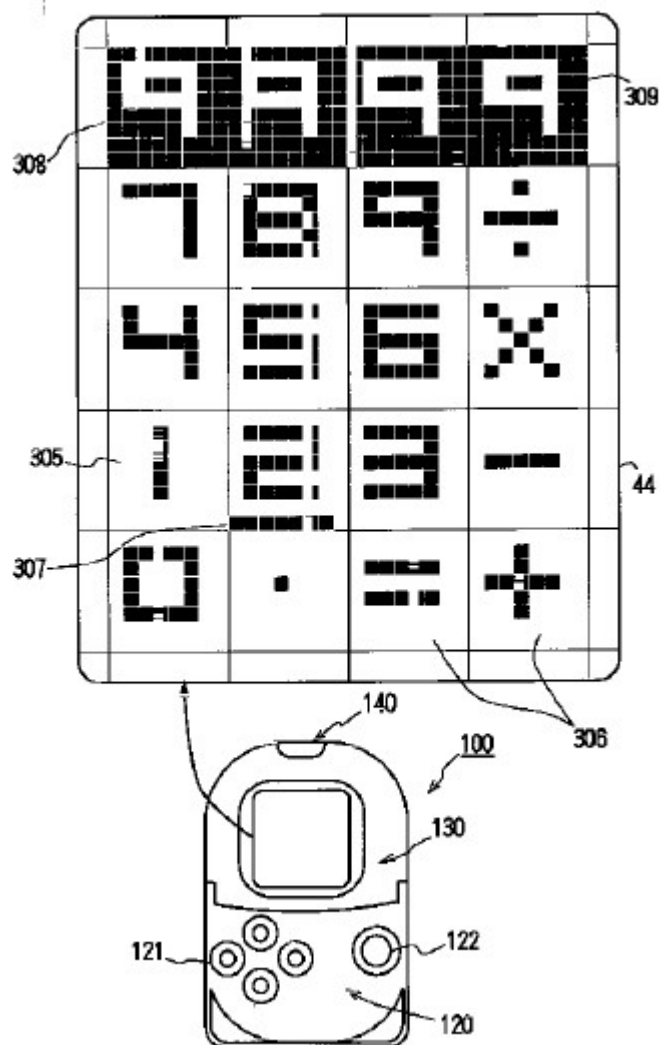
[FIGURE 19]



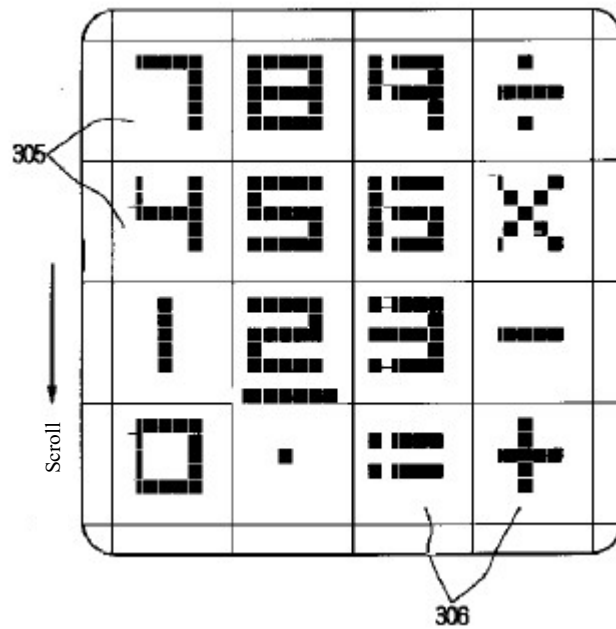
[FIGURE 20]



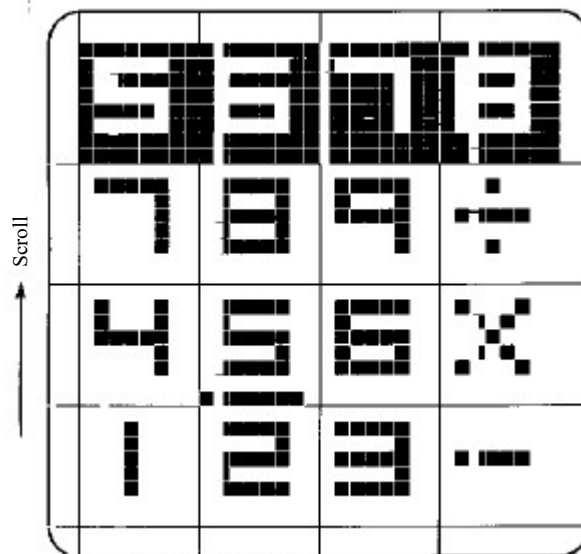
[FIGURE 21]



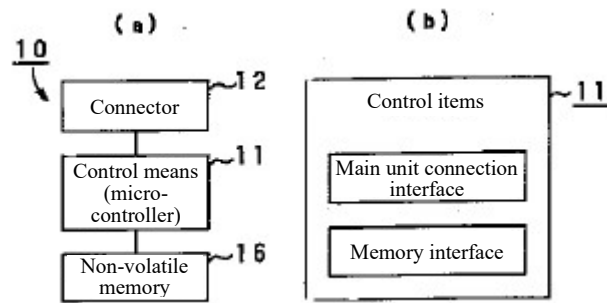
[FIGURE 22]



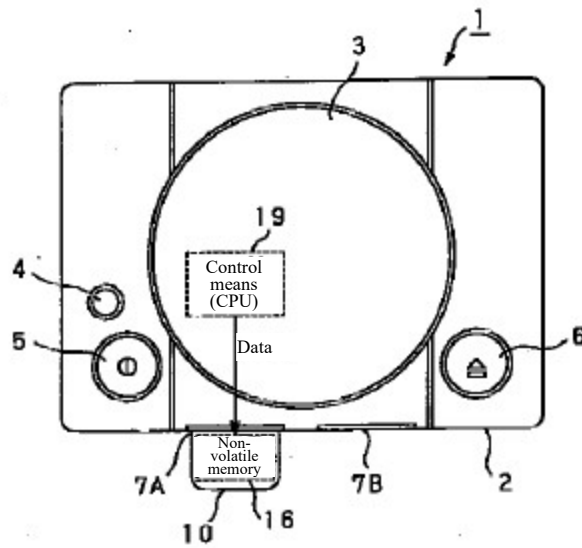
[FIGURE 23]



[FIGURE 24]



[FIGURE 25]



[FIGURE 26]



September 29, 2025

Re: JP_2000148694_A_Nakano

To Whom It May Concern:

This is to certify that the above-referenced document (**390-46376_JP_2000148694_A_Nakano_JA into EN**) has been translated from Japanese into English by a professional translator on our staff who is skilled in the Japanese language.

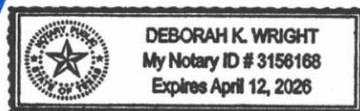
The English translation conforms essentially to the original Japanese except for those words or phrases for which there are no equivalents. Such words or phrases are noted in the translation along with the best English meaning.

All statements made in this declaration of our own knowledge are true, and all statements made on information and belief are believed to be true. We certify these statements under the understanding that willful false statements and the like are punishable by fine or imprisonment, or both (18 U.S.C. 1001). To the best of our knowledge, the aforementioned documents are a true, full, and accurate translation into English of the specified document.

Tonja Shepard
TONJA SHEPARD

Subscribed and sworn to before me on September 29, 2025.

Deborah K. Wright
Deborah K. Wright
Notary Public, State of Texas



My commission expires on April 12, 2026