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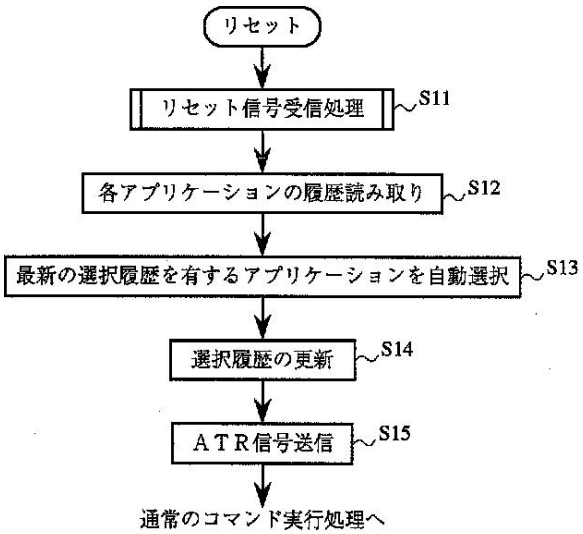
(54) [TITLE OF THE INVENTION]
IC Card

(57) [ABSTRACT]
[PROBLEM]
To select efficiently an application program that is to be executed.
[MEANS FOR RESOLUTION]
A plurality of application programs is stored in an EEPROM, and an application selection command is applied from a reader/writer device side to select an application to be executed, and said application is launched. Each time an application is selected, a selection history, including the date and time, is recorded in the EEPROM. If a reset signal is applied to the CPU from the outside, then, after executing a reset signal receiving process (S11), the selection history for each application is read in (S12), the application that has the most recent selection history is selected automatically (S13), and the selection history is updated (S14). The result of the automatic selection is sent, together with the ATR signal that is the response to the reset, to the reader/writer device (S15), and the process transitions to a state awaiting a command.



[TOP] Reset
S11: Reset Signal Receiving Process
S12: Read in histories for each of the applications.
S13: Select automatically the application that has the most recent selection history.
S14: Update the selection history.
S15: Send ATR signal.
[BOTTOM] To the normal command execution process

[Patent Claims]
[Claim 1]
An IC card that has a CPU and a memory, wherein a plurality of application programs stored in the memory can be executed selectively by the CPU is provided with
a function wherein a selection history of application programs is left in the interior thereof, and wherein a specific application program is selected automatically based on the selection history at the start of accessing from an external device.
[Claim 2]
An IC card set forth in claim 1, wherein:
an application program is selected automatically when a reset signal has been applied to the CPU.
[Claim 3]
An IC card set forth in claim 2, wherein:
information identifying the application program that is selected automatically is asserted, together with a response signal in respect to the reset signal, to the external device.
[Claim 4]
An IC card set forth in any of claims 1 through 3, wherein:
the selection history is referenced to select automatically the application program that has been selected the most recently.
[Claim 5]
An IC card set forth in any of claims 1 through 3, wherein:
the selection history is referenced to select automatically the application program that has the highest selection frequency within a prescribed time interval.
[Detailed Explanation of the Invention]
[0001]
[Field of Technology of the Present Invention]
The present invention relates to an IC card, and, in particular, relates to an IC card that has a CPU and a memory, and wherein a plurality of application programs stored in the memory can be executed selectively by the CPU.
[0002]
[Prior Art]
Optical cards and IC cards have started to be used broadly instead of the magnetic cards that have been used as cash cards and credit cards. In particular, IC cards, which have built-in CPUs, have the benefit of enabling use in high-value transactions given their ability to secure high levels of security.
[0003]
At present, ROMs, EEPROMs, and RAMs, as memory, are built into the CPU-equipped IC cards that are typically used. Normally a basic program that is to be executed by the CPU is stored in the ROM, and user data and various types of application programs are stored in the EEPROM, where the RAM is used as the work area for the CPU. Because the EEPROM is rewritable memory, data and application programs required for each user can be stored there.
[0004]
An external device, known as a "reader/writer device," is used where writing data and programs to the IC card, or when reading out from the IC card. The data and programs are sent back and forth through a physical transmission line or a non-contact transmission path between the external device and the IC card. Normally transmission of information from the external device two the IC card is through assertion in the form of commands, where the various instructions and data are sent to the IC card side as information within the commands. In contrast, transmission of information from the IC card to the external device is asserted in the form of responses, where the processing results and data are conveyed to the external device side as information within the responses.
[0005]
Because the level of integration in memory devices such as EEPROMs is constantly improving, in the typical IC card of today it has become possible to store multiple application programs within an EEPROM. For example, it becomes possible to use a single IC card as a medical history card, a credit card, and as a gasoline refueling card through storing in the EEPROM, and selectively executing, multiple application programs for different purposes, such as, respectively, a program for medical diagnostics, a program for credit transactions, a program for paying for gasoline, and the like.
[0006]
[Problem Solved by the Present Invention]
It is anticipated that the forms of use for IC cards will become increasingly diverse in the future, so the use method will be generalized so as to select and execute a required application program from among multiple application programs that have been stored in advance. Because of this, an operation is necessary to first select one of the application programs when connecting the IC card to the external device to start accessing the IC card. Normally the selection operation is carried out by asserting an application selection command from the external device side. For example, if an IC card on which the three types of applications, described above, are stored is inserted into an external device (a reader/writer device) that is equipped in a hospital, and operation would be necessary to assert an application selection command to select the medical diagnostics program to the IC card from the outside. On the IC card side, a process is carried out based on the application selection command to place, into a selected state, a specific application program that has been designated, and a process is carried out to transmit, to the external device, a response indicating that the selection has been completed. Upon receipt of the transmission of this response, the external device is then able to assert the actual command (a command relating to the medical diagnostics program) to the IC card side.
[0007]
In this way, in an IC card of a type wherein there is selective execution of multiple application programs, a series of operations is necessary to select the specific application program at the start of access from the outside. However, such a process for selecting an application is not necessarily efficient. In particular, because a serial transmission method that uses a single line is used in transmission of signals between the external device and the IC card, some amount of time is required in the process of transmitting the command, performing the selection process within the IC card, and transmitting the response,

inevitably resulting in latency before the actual operation can be started.

[0008]

Given this, the object of the present invention is to provide an IC card wherein an application program that is to be executed can be selected efficiently.

[0009]

[MEANS FOR SOLVING THE PROBLEM]

(1) A first aspect of the present invention is an IC card that has a CPU and a memory, wherein a plurality of application programs stored in the memory can be executed selectively by the CPU is provided with a function wherein a selection history of application programs is left in the interior thereof, and wherein a specific application program is selected automatically based on the selection history at the start of accessing from an external device.

[0010]

(2) A second aspect of the present invention is that, in the IC card according to the first aspect, set forth above, an application program is selected automatically when a reset signal has been applied to the CPU.

[0011]

(3) A third aspect of the present invention is that, in the IC card according to the first second, set forth above, information identifying the application program that is selected automatically is asserted, together with a response signal in respect to the reset signal, to the external device.

[0012]

(4) A fourth aspect of the present invention is that, in the IC card according to the first through third aspects, set forth above, the selection history is referenced to select automatically the application program that has been selected the most recently.

[0013]

(5) A fifth aspect of the present invention is that, in the IC card according to the first through third aspects, set forth above, the selection history is referenced to select automatically the application program that has the highest selection frequency within a prescribed time interval.

[0014]

[EMBODIMENTS OF THE INVENTION]

The present invention will be explained below based on the embodiments that are illustrated. FIG. 1 is a block diagram depicting a state wherein information exchange is carried out between a typical IC card 10 and an external device (a reader/writer device) 20. In this example, the IC card 10 comprises a CPU 11 that has a variety of calculation processing functions, an I/O interface 12 that carries out exchange of information with the external device 20, and memory that is a ROM 13, a EEPROM 14, and a RAM 15. The ROM 13 is a nonvolatile memory that cannot be overwritten, and the CPU 11 executes prescribed processes based on a basic program that is stored in this ROM 13. The EEPROM 14 is a rewritable non-volatile memory, and stores user data and various application programs. The RAM 15 is a rewritable volatile memory that is used as the work area when the CPU 11 executes various processes.

[0015]

The IC card 10 and the external device 20 are connected together through a method such as connecting through a physical signal line, connecting through infrared signals, a non-contact connection through the use of electromagnetism, or the like, to carry out information exchange. Information is sent from the external device 20 to the IC card 10 in the form of commands. The commands that have been sent are applied to the CPU 11 through the I/O interface 12. Conversely, information is sent from the IC card 10 to the external device 20 in the form of responses to the commands that have been asserted. The responses are sent from the CPU 11 through the I/O interface 12 to the external device 20.

[0016]

In the present embodiment, the application program is stored in an application storing region 140 that is provided in the EEPROM 14, as illustrated in FIG. 2. In the example in the figure, respective application programs 1, 2, and 3 are stored in partitions 141A, 142A, and 143A in the application storing region 140. One of the distinctive features of the present invention is the point that the configuration is such that selection histories are recorded, through providing partitions 141B, 142B, and 143B for storing the selection histories of the individual application programs. Selection histories of the respective application programs 1, 2, and 3 are recorded in these partitions 141B, 142B, and 143B.

[0017]

Here, as an example, let us assume that the application programs 1, 2, and 3 are, respectively, a program for medical diagnostics, a program for credit transactions, and a program for paying for gasoline. In this case, this IC card 10 can be used as a medical history card, a credit card, and a gasoline fueling card, and a specific application program is selected depending on the purpose.

[0018]

Conventionally, the selection operation has been carried out based on an instruction from the external device 20 side. For example, when this IC card 10 is inserted into an external device 20 that is equipped in a hospital, an application selection command for selecting the program for medical diagnostics is applied to the CPU 11 following a reset signal. Through this, the program for medical diagnostics is launched in the IC card 10, producing a state wherein a command for the program for medical diagnostics can be received. If this same IC card 10 is inserted into an external device 20 that is equipped in a shopping center, an application selection command for selecting a program for a credit transaction is applied to the CPU 11 after the reset signal. This launches the program for a credit transaction within the IC card 10, producing a state wherein this program for a credit transaction can receive.

[0019]

Even in the IC card 10 according to the present invention, the application that is to be started can, of course, be selected through application of an application selection command, as described above, from the external device 20 side. However, in the IC card 10 according to the present invention there is a function wherein, at a stage prior to the assertion of the application selection command from the external device 20 side, an application that has a high probability of being selected is selected automatically. While specific techniques for determining which application has a high probability of being selected will be

described below, at the point in time that access to the IC card 10 according to the present invention is started, the state will be one wherein one application has already been selected automatically. A response indicating which application has been selected automatically within the IC card 10 is sent to the external device 20 side, so if the application that has been selected automatically is the correct application that is to be executed, the external device 20 can send a command to that application immediately. That is, this eliminates the need to assert the application selection command, as has been done conventionally. On the other hand, if the application that was selected automatically is not the application that is to be executed, then, as has been done conventionally, a command for selecting the application should be asserted to perform the operation for selecting the correct application instead.

[0020]

In the present invention, the selection history from the past is used as the decision basis for determining the application that has a high probability of being selected. Because of this, in the IC card according to the present invention a process is carried out to record, as the selection history, the date and time each time a specific application is selected. For example, in the example case depicted in FIG. 2, when application program 1 is selected, the date and time is recorded, as the selection history, in partition 141B. If selected n times in the past, a total of n dates and times will be recorded. However, because the storage capacity of the partition 141B is finite, if the storage space within the partition becomes full, a deleting process is carried out, starting with the oldest dates and times. Similarly, the dates and times at which application programs 2 and 3 have been selected are recorded as the selection histories in the respective partitions 142B and 143B.

[0021]

When the external device 20 starts accessing the IC card 10, the CPU 11 carries out a process to reference the selection histories that are recorded for each of the application programs, to select a specific application program (an application that has a high probability of being selected) automatically. Specifically, in the embodiment depicted here, this automatic selection process is executed when a reset signal has been asserted to the CPU 11. Normally a reset signal is sent from the external device 20 to the CPU 11 within the IC card 10 immediately after the IC card 10 and the external device 20 are connected. Given this, it is convenient to execute the automatic selection process following the processes that are carried out within the IC card 10 (where normally a process is carried out to set various default values) when this reset signal has been received.

[0022]

One candidate for an application that has a high probability of being selected is the application that has been selected most recently. For example, in a situation such as shopping in a shopping center, the IC card is used each time a purchase is made, at which time the program for a credit transaction is selected and executed. Consequently, if the application that was selected most recently is the program used for a credit transaction, then there will be a high probability that the application that should be selected the next time the IC card is used will be the program for a credit transaction. Consequently, the approach of always selecting automatically the application that was selected most recently is an approach that makes sense.

[0023]

FIG. 3 is a flowchart depicting the processes in the automatic selection process that are carried out within the IC card 10 when such an approach is used. First, when the reset signal is asserted from the external device 20 side, the reset signal receiving process is carried out in Step S11. This process is a process that sets up various data within the RAM 15, and applies specific settings based on specific data within the EEPROM 14; however, because this has no direct bearing on the main point of the present invention, detailed explanations thereof will be omitted. Following this, in Step S12, the histories of the various applications are read. Specifically, the selection histories (the dates and times wherein selections were made) are read out from the partitions 141B, 142B, and 143B in FIG. 2. Given this, in Step S13, the application that has the most recent selection history (that is, the most recent date and time) is selected automatically, after which, in Step S14, the selection history for this selected application is updated (the current date and time is recorded as selection history).

[0024]

Lastly, in Step S15, an ATR signal is transmitted. This ATR (Answer To Reset) signal is a response to the reset signal that was applied from the external device 20 side, a signal for notifying the external device 20 side that the reset signal reception process has been completed and that preparations for receiving a command have been made. In the present embodiment, information indicating which application was selected automatically is sent, together with the ATR signal, to the external device 20. In the standards for typical IC cards, arbitrary data bits may be included, in addition to the prescribed data bits, in the ATR signal. In the present embodiment, a method is used wherein information for identifying the application that has been selected automatically is sent to the external device 20 as these arbitrary data bits. Through this ATR signal, the external device 20 can identify that the IC card 10 side is in a state wherein it can receive a command, and also identifies that the specific application has been selected automatically. The normal process for executing commands, described below, is carried out after the ATR signal has been transmitted.

[0025]

On the other hand, another approach to determining an application that has a high probability of being selected is the method the application program that has the highest selection frequency is selected automatically. Despite being an IC card that can be used in many different applications, these applications are not all used uniformly; normally there will be a use pattern that is biased toward a specific application, depending on the user. Consequently, the application that has the highest frequency of use in the past can be considered to have a high probability of being selected next. Given this, an approach wherein a prescribed interval, such as the past week or the past month, is set, and the application that has the highest selection frequency during this prescribed interval is selected automatically, is an approach that makes sense.

[0026]

FIG. 4 is a flowchart depicting the processes in the automatic selection process that are carried out within the IC card 10 when such an approach is used. First, when the reset signal is asserted from the external device 20 side, the reset signal receiving process is carried out in Step S21. Following this, in Step S22, the histories of the various applications are read. That is, the selection histories (the dates and times wherein selections were made) are read out from the partitions 141B, 142B, and 143B in FIG. 2. Given this, in Step S23, the numbers of times, during the prescribed interval, that each application has been selected are counted. For example, the number of times wherein the date and time have been recorded during the past week would be counted. Given this, in Step S24, the application that has the greatest count value is selected automatically, after which, in Step S25, the selection history for this selected application is updated (the current date and time is recorded as selection history). Lastly, in Step S25, an ATR signal is transmitted. Information indicating which application was selected automatically is sent, together with the ATR signal, the same way it was in the example described above.

[0027]

FIG. 5 is a flowchart depicting the processing of the normal command execution processes that are carried out in the IC card 10 after completion of the processes depicted in FIG. 3 or the processes depicted in FIG. 4. At the time that this command execution process is carried out, the specific application has already been selected automatically, and the external device 20 side has been notified as to which application was selected automatically. If the application that was selected automatically is the application that will actually be used, the external device 20 sends a command for that application; however, if it is not the application that is actually to be used, the external device 20 sends an application selection command to select the application that is actually to be used. In the first of these cases, the process for sending the application selection command can be omitted. While in the latter of these cases an operation for sending the application selection command is necessary, this is the normal process that is carried out in a conventional IC card.

[0028]

Given this, on the IC card 10 side, in Step S31 a standby state for reception of a command is produced. When a command is received from the external device 20 side, then, in Step S32, a determination is made as to whether or not this command is an application selection command. As described above, if the application that was selected automatically is the application that is actually to be used, the external device 20 will transmit a command to that application, and thus processing advances from Step S32 to Step S33, where the command that was asserted is executed. On the other hand, if the application that was selected automatically is not the application that is actually to be used, the external device 20 sends an application selection command for selecting the application that is actually to be used, so processing advances from Step S32 to Step S34, and, based on the application selection command that is asserted, a process for selecting an application (a process for switching from the application that was selected automatically to a newly selected application) is carried out, after which, in Step S35, a process for updating the selection history, that is, a process for recording the selection history for the newly selected application, is carried out. In this case, if necessary a process for correcting the selection history for the application that had already been selected automatically (a process for, for example, removing the date and time in the selection history to make a correction because the automatic selection that had been made previously was selected in error) may be carried out.

[0029]

In either case a prescribed response is sent to the external device 20 in Step S36. This same process is executed repeatedly through Step S37, and when a command for terminating execution of the application is asserted, the process is terminated through Step S37.

[0030]

In this way, the function that is carried out in the present invention to select an application automatically is ultimately a function for predicting and selecting an application that has a high probability of being selected, and thus this automatic selection will not necessarily be the correct selection. However, if an automatic selection is made based on the approach described above, the probability that a correct selection will be made automatically will be high, with a high probability that the application selection command can be eliminated. Moreover, even if the automatic selection is an incorrect selection, the correct selection can be made through the conventional method, through asserting an automatic selection command, so, in practice, there is no disadvantage whatsoever.

[0031]

While, in the above, the present invention was explained based on an illustrated embodiment, the present invention is not limited to this embodiment, but rather may be carried out in a variety of other forms as well. For example, while in the embodiment set forth above the application programs were stored in a EEPROM 14, the present invention can be applied also to IC cards wherein the application programs are stored in the ROM 13. However, in regard to the selection history in this case, it would be necessary to record the selection history in a rewritable EEPROM 14.

[0032]

Moreover, while in the embodiment set forth above the explanation was for a processing operation that assumed that a selection history has already been recorded, it will be necessary to carry out the automatic selection through a different method when the IC card is used for the first time. That is, an automatic selection based on the selection history is not possible when the IC card is used for the first time, as there would be no record at all of a selection history from the past, and thus a method should be used such as automatic selection of the application that is stored at the lowest address in memory, for example. Conversely, a method may be used wherein the application selection command that will be asserted from the external device 20 side is awaited, rather than executing an automatic selection process.

[0033]

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