(19) Japan Patent Office (JP)

(12) Publication of Unexamined Patent Application (A)

(11) Japanese Patent Application Publication Number
Patent Application 2000-163539
(P2000-163539A)

(43) Pub. Date June 16, 2000 (2000.6.16)

(51) Int. Cl.[7]	ID No.	FI		Theme code (Reference)	
G06K 19/07		G06K	19/00	N	5B035

Request for examination Not requested No. of claims 5 FD (Total 7 Pages)

(21) App. No. Pat. App. Hei 10-350726

(22) Filing Date November 25, 1998 (1998.11.25)

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F Term (Reference) 5B035 AA02 AA06 CA11

(54) [Title of the Invention] IC Card

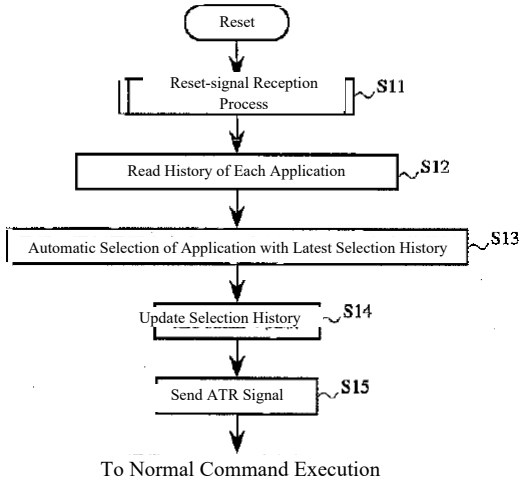
(57) (Abstract)

[Problem]

Efficiently to select an application program to be executed.

[Means for Solving the Problems]

Store a plurality of application programs in EEPROM, select an application to be executed by giving an application-selection command from a reader-writer apparatus, and execute this. Each time an application is selected, record a selection history that includes that date and time in the EEPROM. When a reset signal is given to the CPU from outside, read a selection history of each application (S12) after executing the reset-signal reception process (S11), automatically select an application having a latest selection history (S13), and update the selection history (S14). Send a result of the automatic selection to the reader-writer apparatus along with an ATR signal that responds to a reset (S15), and shift the reader-writer apparatus to a state where it is waiting for a command.



[Scope of Claims for Patent]
[Claim 1]
In an IC card comprising a CPU and a memory, and that can selectively execute a plurality of application programs stored in the memory using the CPU, the IC card leaves a selection history of application programs, and comprises a function for automatically selecting an application program based on the selection history, when accessing from an external apparatus.
[Claim 2]
The IC card according to claim 1, wherein automatic selection is implemented for an application program when a reset signal is given to the CPU.
[Claim 3]
The IC card according to claim 2, wherein information specifying an automatically-selected application program is given to an external apparatus along with a response signal to the reset signal.
[Claim 4]
The IC Card according to any one of claims 1-3, wherein
an application program most recently selected is automatically selected by referencing a selection history.
[Claim 5]
The IC Card according to any one of claims 1-3, wherein
an application program having the highest selection frequency within a predetermined period is automatically selected by referencing a selection history.
[Detailed Description of the Invention]
[0001]
[Technical Field of the Invention]
The present invention relates to IC cards, and particularly to an IC card having a CPU and a memory, and in which a plurality of application programs stored in the memory can be selectively executed by the CPU.
[0002]
[Prior Art]
Optical and IC cards are beginning to become popular instead of magnetic cards that have been used as cash and credit cards. Particularly, an IC card with a built-in CPU can ensure a high level of security, so it has an advantage of being used for high-price commercial transactions.
[0003]
Currently, ROM, EEPROM, and RAM are built into a memory on an IC card having a commonly used CPU. Normally, a basic program to be executed by the CPU is stored in ROM, user data, various application programs, and the like are stored in EEPROM, and RAM is used as a work area for the CPU. EEPROM is a rewritable memory, and for that reason, data necessary for each user, application programs, and the like can be stored here.
[0004]
An external apparatus, called a reader-writer apparatus, is used when writing data and programs and the like to an IC card, and when reading them. Data and programs are sent to and from this external apparatus via a physical transmission line or a non-contact transmission path. Normally, the transmission of information from the external apparatus to the IC card is attained in the form of commands; various instructions, data, and the like are communicated to the IC card as one piece of information in the commands. In contrast, the transmission of information from the IC card to the external apparatus is attained in the form of a response; the processing results and data, and the like are communicated to the external apparatus as a piece of information in this response.
[0005]
Because a degree of integration of memories such as EEPROM or the like is increasing year by year, a current, general IC card can store a plurality of application programs in EEPROM. For example, if a plurality of application programs corresponding to use, such as a medical diagnostic program, a credit-settlement program, or a gasoline-charge payment program or the like, is stored in EEPROM, respectively, the IC card can be used as a diagnostic card, a credit card, and a gasoline-refueling card by selectively executing these.
[0006]
[Problem to be Solved by the Invention]
It is expected that usage formats for IC cards will continue to diversify in the future, and it is thought that a usage format in which the necessary application program is selected and executed from among a plurality of pre-stored application programs will be generalized. For that reason, an operation for selecting one of the application programs is necessary first when connecting an IC card to an external apparatus and starting access. Normally, this selection operation is implemented by giving an application-selection command from the external apparatus. For example, in a case in which an IC card storing three types of application programs, as described above, is inserted into an external apparatus (a reader-writer apparatus) installed at a hospital, it is first necessary to implement an operation for providing an application-selection command for selecting a medical diagnostic program to the IC card from the external apparatus. On the IC card, a process for putting a specified specific application program into a selected state is implemented based on this application-selection command, and a process is implemented to send a selection-completed response to the external apparatus. The external apparatus can give the original command (command for the medical diagnostic program) to the IC card after receiving this response.
[0007]
In this way, with an IC card of the type that selectively executes a plurality of application programs, a series of operations for selecting a specific application program was required when starting access from outside. However, such an application-selection procedure is not

always efficient. In particular, a serial-transmission method using a single signal line is used for signal transmission between the external apparatus and the IC card. For that reason, a certain amount of time is required for processes such as the transmission of commands, the selection process on the IC card, the transmission of responses; a waiting time inevitably occurs until the work to be done can be started.

[0008]

Accordingly, an object of the present invention is to provide an IC card that makes it possible efficiently to select an application program to be executed.

[0009]

[Means for Solving the Problem]

(1) A first aspect of the present invention is in an IC card having a CPU and a memory, a plurality of application programs stored in the memory can be selectively executed by the CPU; a selection history of an application program is left internally, and a function is disposed for automatically selecting a specific application program based on the selection history when starting access from an external apparatus.

[0010]

(2) A second aspect of the present invention is an IC card according to the first aspect described above, in which an automatic selection of an application program is implemented when a reset signal is given to the CPU.

[0011]

(3) A third aspect of the present invention is an IC card according to the second aspect described above, in which information specifying an automatically-selected application program is given to the external apparatus along with a response signal for the reset signal.

[0012]

(4) A fourth aspect of the present invention is an IC card according to the first to third aspects described above, in which an application program most recently selected is automatically selected by referencing a selection history.

[0013]

(5) A fifth aspect of the present invention is an IC card suspended in the first to third aspects described above, in which an application program having the highest selection frequency within a predetermined period is automatically selected by referencing a selection history.

[0014]

[Mode for Carrying Out the Invention]

A description will be based on embodiments that illustrate the present invention. Fig. 1 is a block diagram illustrating a state in which information is being transmitted between a general IC card 10 and an external apparatus (a reader-writer apparatus) 20. In this example, the IC card 10 is equipped with a CPU 11 having various computation processing functions, an I/O interface 12 that sends and receives information to and from the external apparatus 20, and a memory composed of a ROM 13, an EEPROM 14, and a RAM 15. The ROM 13 is a non-volatile memory that cannot be written; the CPU 11 executes predetermined processes based on basic programs stored in the ROM 13. EEPROM 14 is a non-volatile memory that can be written, and stores user data, and various application programs, and the like. RAM 15 is a rewritable, volatile memory used as a work area by the CPU 11 when executing various processes.

[0015]

The IC card 10 and the external apparatus 20 are connected to each other using a method such as a connection made using a physical signal line, a connection made using an infrared signal, a contact-less connection using electromagnetism or the like, and information is sent and received. The external apparatus 20 sends information in the form of commands to the IC card 10. Sent commands are given to the CPU 11 via an I/O interface 2. Conversely, information is sent from the IC card 10 to the external apparatus 20 in the form of a response to the given command. This response is sent from the CPU 11 to the external apparatus 20 via the I/O interface 12.

[0016]

In this embodiment, an application program is stored in an application storage region 140 disposed in the EEPROM 14, as shown in Fig. 2. In the illustrated example, application programs 1, 2, and 3 are stored in the partitions 141A, 142A, and 143A, respectively, in the application storage region 140. Another feature of the present invention is that partitions 141B, 142B, and 143B are disposed for storing a selection history of each application program; the selection history is recorded. Selection histories of the application programs 1, 2, and 3 are recorded in these partitions 141B, 142B, and 143B, respectively.

[0017]

Here, it is assumed that the application programs 1, 2, and 3 are a medical-diagnostic program, a credit-settlement program, and a gasoline-payment program, respectively. In this case, this IC card 10 can be used as a diagnostic card, a credit card, and a gasoline refueling card; a specific application program is selected in response to the usage.

[0018]

Conventionally, this selection operation was implemented on the basis of an instruction from the external apparatus 20. For example, by inserting the IC card 10 into the external apparatus 20 installed at a hospital, an application-selection command for selecting a medical-diagnostic program is given, following a reset signal to the CPU 11. As a result, the medical-diagnostic program is launched on the IC card 10, and thereafter, a command for the medical-diagnostic program is accepted. Also, by inserting the same IC card 10 into the external apparatus 20 installed at a shopping center, an application-selection command for selecting a credit-settlement program is given, following a reset signal to the CPU 11. As a result, a

credit-settlement program is launched on the IC card 10, and thereafter, the credit-settlement program is accepted.

[0019]

The IC card 10 according to the present invention can, of course, also select an application to be launched by giving an application-selection command such as that described above from the external apparatus 20. However, the IC card 10 according to the present invention has a function for automatically selecting an application having a high probability of being selected at a stage prior to an application-selection command being given from the external apparatus 20. A specific method for determining which application with a high probability of being selected is described later, but at the point in which accessing of the IC card 10 according to the present invention is started, a single application has already been automatically selected. In the IC card 10, which application has been automatically selected is communicated to the external apparatus 20 as a response, so in a case where the application that has been automatically selected is the correct application to be executed, the external apparatus 20 can immediately send a command for that application. In other words, it is no longer necessary to give an application-selection command, as is conventionally the case. Conversely, in a case where an automatically-selected application is not an application to be executed, an application-selection command may be issued as was conventionally implemented, and the correct application-selection operation may be implemented again.

[0020]

In the present invention, a past selection history is used as judgment material for determining an application with a high probability of being selected. For that reason, in an IC card according to the present invention, a process is implemented that records a date and time as a selection history each time a specific application is selected. For example, in the example shown in Fig. 2, when application program 1 is selected, that date and time is recorded in the partition 141B as the selection history. In a case where an application has been selected n times in the past, a total of n dates and times is recorded. However, the storage capacity of the partition 141B is limited, and for that reason, in a case where the storage space in the partition has become saturated, processing is implemented so that storage space is deleted from the oldest date and time. Similarly, the dates and times of the selection of application programs 2 and 3 are recorded in the partitions 142B and 143B, respectively.

[0021]

When the external apparatus 20 starts accessing the IC card 10, the CPU 11 references a selection history recorded for each application program, and implements a process for automatically selecting a specific application program (an application with a high probability of being selected) based on the selection history. Specifically, in the embodiment described here, this automatic-selection process is executed when a reset signal is given to the CPU 11. Normally, a reset signal is sent from the external apparatus 20 to the CPU 11 on the IC card 10 immediately after the IC card 10 and the external apparatus 20 are connected. Then, it is convenient to execute this automatic-selection process after the processes implemented on the IC card 10 (typically, various initialization processes are implemented) when the reset signal is received.

[0022]

One candidate for an application with a high probability of being selected is the most recently selected application. For example, in a situation of shopping at a shopping center, an IC card is used for each purchase, and a credit-settlement program is selected and executed each time. Therefore, if a most recently selected application was a credit-settlement program, it is likely that the application that will be selected at the next use will also be the credit-settlement program. Therefore, an approach of always automatically selecting the most recently-selected application is an adequately meaningful approach.

[0023]

Fig. 3 is a flowchart illustrating a procedure of an automatic selection process implemented on the IC card 10 in a case in which such an approach is adopted. Firstly, when a reset signal is given from the external apparatus 20, the reset signal-reception process is implemented at Step S11. This process sets various data in RAM 15, and implements specific settings based on specific data in EEPROM 14, but because it is not directly related to the intent of the present invention, a detailed description will be omitted. Next, at Step S12, a history of each application is read. Specifically, the selection history (the date and time when a selection was made) in the partitions 141B, 142B, and 143B shown in Fig. 2 is read. Then, at step S13, an application having a latest selection history (in other words, a latest date and time) is automatically selected, and at a subsequent Step S14, the selection history of the selected application is updated (the current date and time is newly recorded as the selection history).

[0024]

Lastly, at Step S15, an ATR signal is sent. This ATR (Answer To Reset) signal is a response to a reset signal given from the external apparatus 20. It is a signal for notifying the external apparatus 20 that the reset-signal reception process is complete and that preparation has been made to receive the command. In the present embodiment, information specifying which application is automatically selected is sent to the external apparatus 20 along with this ATR signal. In a typical IC card standard, the ATR signal can be predetermined data bits in the ATR signal, or included in any data bits. In the present embodiment, a method for conveying information for specifying an automatically-selected application to the external apparatus 20 is adopted as

arbitrary data bits. The external apparatus 20 can recognize that the IC card 10 has accepted a command using this ATR signal, and can also recognize that a specific application has been automatically selected. After this ATR signal is sent, a normal command, described below, and execution process are implemented.

[0025]

Conversely, another approach to determining an application with a high probability of being selected is a method of automatically selecting an application program with the highest selection frequency within a predetermined period of time. Even with an IC card that can be used for a large number of purposes, these usages are not uniformly used. Normally, often times the form of use is biased toward a specific usage for each user. Therefore, the application that has been most frequent use in the past can be said to have a high probability of being selected next time. For that reason, an approach in which a predetermined period is set in advance, such as the past week or the past month, and an application having the highest selection frequency within the predetermined period is automatically selected, for example, is an approach that is adequately meaningful.

[0026]

Fig. 4 is a flowchart illustrating a procedure of an automatic selection process implemented on the IC card 10 in a case in which such an approach is adopted. Firstly, when a reset signal is given from the external apparatus 20, the reset signal-reception process is implemented at Step S21. Next, at Step S22, a history of each application is read. In other words, the selection history (the date and time when a selection was made) in partitions 141B, 142B, and 143B shown in Fig. 2 is read. Then, at Step S23, the number of selections within a predetermined period is counted for each application. For example, the number of times a date and time has been recorded in the past week is counted. Then, at Step S24, an application having a maximum count value is automatically selected, and at a subsequent Step S25, the selection history of the selected application is updated (the current date and time is newly recorded as the selection history). Lastly, at Step S25, an ATR signal is sent. The point that information that specifies which application is the automatically selected application is sent along with this ATR signal is the same as in the example described above.

[0027]

Fig. 5 is a flowchart illustrating a procedure of a normal command-execution process implemented on the IC card 10 after the procedure illustrated in Fig. 3 or 4 is completed. At the point at which the command execution process is implemented, a specific application has already been automatically selected, and the external apparatus 20 is notified of which application has been automatically selected. In a case in which the automatically-selected application is an application that should have been executed, the external apparatus 20 sends a command for that application, but in a case in which the application is not an application that should have been executed, the external apparatus 20 sends an application-selection command for selecting the application that should have been executed. In the former case, the procedure for sending an application-selection command can be omitted. In the latter case, an operation for sending an application-selection command is necessary, but this is a normal process implemented by conventional IC cards.

[0028]

Now, the IC card 10, at Step S31, is in a standby state for receiving a command. When a command from the external apparatus 20 is received, it is determined at Step S32 whether the command is an application-selection command. As described above, in a case in which the automatically-selected application is an application that should have been executed, the external apparatus 20 sends a command for that application, and therefore, the process shifts from Step S32 to Step S33, in which the given command is executed. Conversely, in a case in which the automatically-selected application is not an application that should be executed, the external apparatus 20 sends an application-selection command for selecting the application that should be executed, and therefore, the process shifts from Step S32 to Step S34, in which a process for selecting the application (a process for switching from the automatically-selected application to the newly-selected application) is implemented on the basis of the given application-selection command. At Step S35, a process is implemented for updating the selection history, or in other words, a process for recording the selection history for the newly-selected application. At this time, if necessary, a process for modifying a selection history for an automatically-selected application may be implemented (a process such as, for example, deleting the date and time of the selection history in order to correct the previously-selected application because the automatic selection that was made was an incorrect selection).

[0029]

In either case, at Step S36, a predetermined response is sent to the external apparatus 20. In a case in which the same process has been repeatedly executed through Step S37 and a command to end execution of the application has been given, the process ends after Step S37.

[0030]

In this way, the automatic-selection function of the application implemented in the present invention is merely a function for predicting and selecting an application with a high probability of being selected, and for that reason, this automatic selection is not necessarily a correct selection. However, if an automatic-selection is made based on an approach such as that described above, it is highly likely that a correct

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