Description

The invention relates to a method for identifying a system-allied physically separable program memory in a data processing system, which comprises a central unit, an executive memory and a device for physically introducing a program memory into the system, said method comprising the following steps:

a) comparing an identifier stored in the program memory with a reference identifier stored in the executive memory;

b) generating an error signal if the reference identifier does not correspond to the identifier in the program memory;

c) disabling, under the control of the error signal, the operation of the data processing system.

The invention also relates to a data processing system utilizing this method.

Such a method is described in the publication IBM TDB Vol. 14, No. 11, April 1972, p. 3531. According to the described method the comparison is performed by the first instruction in the program written in the program memory. This first instruction consists of the comparison of an identifier in the program with a hard-wired identifier in the executive memory of the central unit. An invalid comparison will disable the operation of the data processing system by inhibiting the program run. This means that when a program memory which does not contain the correct identifier, for example, in the case of a program which has been copied by an unauthorized manufacturer, is introduced into the system, the program will not be executed.

The illegal copying and sale of material which is subject to a copyright or which is the property of a trademark owner or such a manufacturer is a serious problem. Examples are the copying of video tapes and the copying of software in computer systems, especially for small computer

systems such as video games. Large profits can be made by the sale of illegally copied programs.

Manufactures of video games sell hardware (for example the console) at only a small profit because they expect to recoup profits from the sale of software, for example software stored in a cartridge. This is one of the main reasons why the software owned by the manufacturer should be effectively protected against copying by unauthorized manufacturers. Therefore, the manufacturer incorporates in his systems or his software a device or a method to prevent such copying or at least make it more difficult. Preferably, the manufacturer tries to design his system in such a way that it can only be used when software to his own system, i.e. software of his own make or of another authorized make, is used.

A drawback of most of the known software protection systems or software protection methods is that they can easily be circumvented. In the method described in said IBM TDB publication the comparison step during which the congruence between the identifiers is checked forms a part of the program written in the program memory, that is to say the first instruction in the program. A skilled but unauthorized copier, will recognize the purpose of this first instruction and will remove or neutralize this first instruction. This means that when the data processing system operates with such a copied program in which this first instruction has been removed, the comparison step will never be performed. Consequently no error signal will be generated and the system will not be disabled.

It is the object of the invention to provide a method for identifying a system-allied physically separable program memory, said method being executed after an initialization of the data processing system and independently of the content of the program memory.

This object is achieved by the method in accordance with the invention in that a reset signal is generated after an initialization of the data processing system, under the control of the reset signal a start-command

signal being generated by the central unit in order to start said comparison.

Thus, when the method in accordance with the invention is used, the central unit generates a start-command signal for starting the comparison after an initialization of the data processing system. The comparison will thus always be performed after an initialization of the system and independently from the instructions written in the program memory. Consequently, there will always be a check on the congruence of the identifiers after the start-command signal has been generated by the central unit. However, this implies that in the case of non-congruence or in the case of absence of the identifiers in the program memory (for example, due to copying), the operation of the data processing system will always be disabled.

Preferably, the method according to the invention is characterized in that the initialization consists of the introduction of a program memory into the device for physically introducing a program memory. Thus, the method of the invention is performed each time when a program memory is introduced into the device for physically introducing a program memory. The system will thus operate only if the introduced program memory has been identified as a system-allied program memory.

Preferably, the initialization consists of the activation of the power supply for the data processing system after the introduction of a program memory into the device for physically introducing a program memory. Thus, the method according to the invention cannot be circumvented by the introduction of a program memory into a system with a deactivated power supply.

The invention also relates to a data processing system comprising a central unit, an executive memory, a device for physically introducing a program memory into the system, a comparator for comparing an identifier written in the program memory with a reference identifier in the executive memory and for generating a comparision result,

and also comprising a disable device for disabling the data processing system under the control of a negative comparision result. The data processing system according to the invention is characterized in that the comparator is an integral part of the data processing system and is activatable under the control of a reset signal generated after an initialization of the system.

In a data processing system according to the invention, the identifier preferably comprises a proprietory indication which consists of a registered trademark, or copyrighted material, or a statement indicating that in this system use is made of the invention as claimed in the present patent application and any patent issuing therefrom.

As has already been described, the comparator is activated after an initialization of the data processing system and, when the identifier written in the program memory is not congruent with the reference identifier, the system is disabled. This means that in order to make a usable program memory the unauthorized manufacturer is forced to store the appropriate identifier in the program memory. Because the identifier is now a proprietory indication, an unauthorized manufacturer will be forced to insert this proprietory indication in order to make a usable program memory. However, this implies an infringement of the law, i.e. the trademark law in the case of a registered trademark and the copyright law in the case of copyrighted material. The unauthorized manufacturer will thus be guilty of counterfeit marking.

It is to be noted that the use of copyrighted material as an identifier has already been described in DE-OS 29 23 738. However, therein the identifier is used in a similar way as in said IBM TDB publication, i.e. as a part of the program written in the program memory. Like the method described in the IBM TDB publication, the method described in DE-OS 29 23 738 can be circumvented again by omitting the copyrighted text and the comparison instruction in the program. If in accordance with the present patent

application the unauthorized manufacturer removes the copyrighted material from the program memory, the data processing system will not operate with such a program memory.

Preferably, a data processing system according to the invention comprises display means connected to the central unit. When applied in such a data processing system, the method according to the invention is preferably characterized in that as a result of said start-command signal the proprietory indication is displayed on said display means for a period of time which is long enough that it is perceptive by humans. Because the proprietory indication is displayed as a video display and/or audible display, infringement of the law can easily be established.

The invention will be described with reference to a preferred embodiment in which the data processing system comprises a video controlled television game console, and the program memory a ROM cartridge. It will be evident that the invention is not restricted to this preferred embodiment but can be applied to all data processing systems, for example computer systems, where use is made of a program memory which is physically introduced in the system, for example a magnetic tape, a disc, or an optical recording medium.

The invention will be described in detail hereinafter with reference to the attached drawings. Therein:

Figure 1 is a block diagram showing the architecture of a programmable video game;

Figure 2 is a cross-reference list of the video game of Figure 1; and

Figure 3 illustrates, using a flow chart, the implementation of the method of the invention in the video game of Figures 1 and 2.

Figure 1 schematically shows the architecture of a bus-oriented, programmable video game. The architecture of Figure 1 is also analogous, for example, to the architecture of some computer controlled apparatus. A microprocessor 10 communicates data, instructions, and address

information, via a bus 11, with a non-volatile memory 12, hereafter called the EXECUTIVE ROM, which contains EXECUTIVE program software, a video generator 13, a random access memory (RAM) 14, a program memory 16, hereafter called the GAME ROM containing software for a particular game and, optionally, with various input-output interfaces 18 which communicate data to one or more accessories, for example a printer or a tape recorder. In a video game the microprocessor 10, the EXECUTIVE ROM 12, the video generator 13 and the RAM 14 are all contained within a single hardware console unit. The GAME ROM 16 and the interfaces 18 are external to and separable from the console. The bus 11 is provided with devices 17 and 19 for physically introducing the GAME ROM or the interfaces 18. These devices are, for example removable connectors.

The microprocessor 10 generally comprises an integrated circuit processor which is capable of addressing and executing program instructions which are stored in the executive ROM 12 and the GAME ROM 16 or in the RAM 14, of reading data resident in the ROM's 12 and 16, and the RAM 14, at the I/O interfaces 18 or in the data registers of the video generator 13. The microprocessor is also capable of writing data at the addresses in the RAM 14, the registers in the video generator 13, and in the I/O interfaces 18.

The video generator 13 may consist of one or more dedicated integrated circuits which produce a raster scan television signal in response to the image data received via the bus (data + address) 11 from the microprocessor 10 and/or one or more memories 12, 14 and 16. The video generator may include a character generator for producing alphanumeric characters in a video image in response to the ASCII coded character information and the position addresses received from the data bus and may, additionally, contain circuits for generating object-oriented displays and/or for mapping information contained in the random access memory 14 to points in the video image. The raster scan television signal produced by the video generator 13

is fed to and displayed on a cathode ray tube 15 which may be contained in the video game console or may be a separate television monitor or receiver. The video generator may also be capable of generating audio signals which are produced either through the television receiver 15 or through a separate loudspeaker in the console.

The microprocessor 10 communicates with the memories 12, 14 and 16 and the registers of the video generator 13 by transmitting discrete address information, identified by those components, over the bus 11. The "address space" of a preferred embodiment of the video game is illustrated in Figure 2. A group of, for example, 4K addressable locations comprises data stored in the EXECUTIVE read-only memory. The EXECUTIVE read-only memory contains data and program routines which are utilized by all or many of the separable game programs executed by means of the console. These may, for example, comprise programs for initializing the console at the start of each game or for generating standard displays.

The address space further includes, for example approximately 32K addresses assigned to the separable GAME ROM 16 which contains program routines and data which are uniquely associated with one or more particular video games and which serve to generate the displays, score keeping, and logic function of those games.

The address space further includes, for example approximately 16K of random access memory 14 which may alternatively be utilized for the storage of a video display in any format (for example, as a direct bit map or in a coded character or object-oriented format) or for scratch-pad data storage.

A comparatively small number of locations of the address space is associated with registers and control functions in the video generator and is utilized by the microprocessor to control the mode and the operation of the generator and to determine the status of the display.

As indicated in Figure 2, the video generator 13 is capable of reading information from the GAME ROM and

of reading and/or writing information in the RAM 14 as well as in its own registers 21. The microprocessor 10 can read and write information in the video generator registers, in the RAM 14, and in the external I/O port and can read information from the GAME and EXECUTIVE ROM's. Hardware circuits associated with the microprocessor 10 automatically read a first program instruction from the address 0 of the EXECUTIVE ROM after initialization of the console. Initialization occurs whenever a voltage is applied to the console, when a "RESET" key is depressed, and when a new GAME ROM 16 is inserted in to the connector 17.

Figure 3 is a flowchart of a preferential form of an initialization routine which implements the method of the present invention in the video game console of Figure 1. Except as indicated in the following text, the initialization routine is implemented as firmware instructions stored in the EXECUTIVE ROM 12 and thus represents, in unalterable form, a physical part of the video game control console hardware. A reset signal (50), whether produced after an initialization upon switching on and by the insertion of a ROM cartridge in the connector 17, or by a manual reset key, causes (51) the microprocessor hardware to generate a start-command signal in order to start the execution of the instruction at the location 0 in the EXECUTIVE read-only memory 12. The location 0 contains an instruction which causes the program execution to jump (52) to an ENABLE routine which is stored at a previously determined location in the EXECUTIVE ROM. The ENABLE routine first issues a command to the video generator 13 which causes the video generator to erase (53) the video display on the blank screen and then proceed to read (54) information from a data table, notably an identifier which is contained at predetermined addresses in the GAME ROM inserted into the connector 17, and to write corresponding information into the video display control area of the RAM.

The video generator 13 may, possibly, include hardware which disables the operation of the audio and/or

video display upon receipt of a given command or a given sequence of commands. After the loading of the data from the GAME ROM into the RAM, the ENABLE routine checks (55) the inserted data in order to determine whether or not it contains instructions which, if applied to the video generator, would disable the generator operation. It is possible that an unauthorized manufacturer circumvents an important aspect of the method of the invention, i.e. the display (57) which will be described hereunder, if he inserts an instruction into the program of the GAME ROM to blank the display of the identifier stored in the program ROM. In order to suppress the effect of such an instruction, the enable routine checks for the presence of such instructions. If such instructions are present (Y) in the RAM, the program loops back to location 0 and will start to execute an endless loop of the previously described program instructions until the GAME ROM is removed. During execution of the loop, the video display will remain blank and the console will be incapable of executing any program code contained in the GAME ROM. In addition (dotted line), the display may be made to present (60) the text "INVALID SOFTWARE" or a similar appropriate message.

If the enable routine determines that the data table does not (N) contain an instruction which would disable the video generator, it utilizes (56) the data contained in the data table which in this case also comprises the identifier stored in the GAME ROM, as a display input to the video generator 13. The microprocessor issues (57) a command to the video generator 13 to display the stored inputted data on the display 15. After the video generator has been enabled and while the image is being displayed, the microprocessor compares (58) the data stored in the RAM 14 and/or the contents of the data table in the GAME ROM 16 with a reference identifier which is recorded at a location(s) in the EXECUTIVE ROM 12. The result of the comparison is negative if the identifier stored for input to the video display is different (N) from the reference identifier stored in the EXECUTIVE ROM, or if no identifier

is present in the GAME ROM (for example, omitted by a copier). If the comparison result is negative, the microprocessor generates an error signal (59) and loops back to the location 0 and continues to execute an endless loop until the GAME ROM is removed. The loop will alternatively clear the screen and present the display (60) defined by the data table in the GAME ROM; however, no execution of programs or other display fields contained in the data stored in the GAME ROM will be permitted.

If the microprocessor determines that the data field stored in the RAM is congruent (Y) with the reference field stored in the EXECUTIVE ROM, the microprocessor then branches (61) to execute a video game or other program contained in the GAME ROM, and the enable routine is terminated (62). So it is realized that the system will only operate in case that a congruent (with the reference identifier) identifier is present in the GAME ROM.

It is one of the advantages of the invention that the display produced by the video generator 13 in response to the data table stored in the RAM is a display which can only legally be used by or with the permission of the manufacturer or proprietor of the console. For example, the display may comprise audio or visual material which is copyrighted by the console proprietor; it may contain one or more registered trademarks or other industrial or commercial property rights of the proprietor or it may present text which unequivocally indicates that the program material originated from, was manufactured by or was produced under license of or with the permission of the proprietor. If the equipment is protected by a patent or is the subject of a patent application, the text may also unequivocally state that fact.

A preferred embodiment of the apparatus which is subject of a patent application could also include a phrase indicating that the apparatus utilizes the invention of that application and/or corresponding foreign applications and/or patents granted thereon or some other similar identifying phrase. For example, such a text could include a

phrase similar to "This apparatus uses the invention of Patent Application entitled "A method for identifying a system-allied physically separable program memory and a data processing system utilizing said method" and assigned to Philips and any patent issuing thereon". This phrase, of course, could also include the filing date of that application, which of course, is the filing date of the present application. Alternatively, the phrase could read "This apparatus utilizes the invention of the Patent Application No. ..... " which would include the number of the application identified two sentences above. The phrase could also include references to corresponding foreign applications and patents. Preferably,. the display is displayed for a period of time which is long enough that it is perceptive by humans; infringements can easily be detected.

Under some conditions it might be found objectionable to display these types of phrase. If it should be so found, the method of the invention can be arranged so that the signals which produce these phrases are short-lived, or that the display is only produced by the video generator 13 on special request, for example by using a special instruction for this purpose, which special instruction could be used whenever an infringement has to be established. It shall be evident that such displays by non-licensed equipment constitute an admission of infringement.

In one of the embodiments in which the subject matter disclosed herein can be used, notably a programmable TV game, the program material, including its instructions and the identifier that will produce the particular desired display, would be contained in a program memory, for example a ROM, mounted in a cassette-like cartridge which is made to be plugged into an electrical connector in a console containing the computer equipment with which the ROM operates.

The information contained in the data table stored in the GAME ROM and read by the enable routine may

be an actual bit pattern memory map of the image to be presented on the display 15. Alternatively, the information in the program ROM data table may be a code which enables a character generator in the video generator 13 to present a display or it may be a predetermined set of characters which are recognized by the microprocessor as an instruction which has no function other than to cause the activation of the RAM, for example by using data stored in the EXECUTIVE ROM to present the indicated display. Likewise, the comparison between the data table and the reference data stored in the EXECUTIVE ROM need not indicate equivalence but merely congruence between the data. As used herein, the term "congruence" means that the data, when processed by the video generator 13, will produce a display having the same recognizable and distinguishing features which can only be used by or with the permission of the console manufacturer.

In a preferred embodiment of the invention, the display is cleared before the image checked by the data in the data table is formed. In this way, it is assured that the display does not contain any text, in addition to the commanded display, which might alter its meaning.

The invention is not restricted to hardware which determines that a predetermined data field is visually displayed at the start of program operation, Thus, in alternative embodiments, the EXECUTIVE ROM routine may contain a program code which ensures that some or all of the displays produced by the data table is shown for the duration of the program contained in the GAME ROM.

Although the preferred embodiment of the invention has been described as a method which is performed in conjunction with a video game hardware console, those skilled in the art will recognize that some or all of the functions described in software terms could alternatively be implemented by hardware circuits and that the circuitry described herein is operable in other computer controlled apparatus, for example medical imaging or machine-controlled apparatus. Likewise, the source of program which is

separable from the console need not be a read-only memory but might, alternatively, be any other known program source which is separable from the console, for example a magnetic tape or disc memory or a modem which receives data from a remote location via a communication circuit.