A DATA STORAGE DEVICE

A memory (43) is arranged to store data such that each item of data has either a first or a second state. A power supply deriver (D1, D2) derives a power supply from a signal supplied to the data storage device. A data reader (44, 45) causes data to be supplied to a memory data output (43a) of the memory (43) in response to the derivation of a power supply. A switch (T) coupled to the data output (43a) is rendered conductive by data having the first state and non-conductive by data having the second state. An impedance (Z) is provided in the power supply path of the data storage device and the switch (T) is coupled in parallel with the impedance (Z) such that, in use, the impedance (Z) is short-circuited when the switch (T) is rendered conductive, whereby the signal supplied to the data storage device is modulated in accordance with data read out from the memory.
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A DATA STORAGE DEVICE

This invention relates to a data storage device, especially but not exclusively, a data storage device for use in a games playing piece or toy and to a games apparatus having a games module for supplying power to one or more such playing pieces.

WO97/23060 describes apparatus for bi-directional data and uni-directional power transmission between a games module and playing pieces. This apparatus uses RF inductive coupling to supply power from the games module to physically separate passive playing pieces. The same RF inductive coupling is used to download data from a playing piece to the games module.

RF inductive coupling between the games module and playing pieces is advantageous because such coupling is possible over a large distance range. However, this very advantage presents problems if it is desired to couple a number of playing pieces to respective different RF coils of the same games module. For example, in the case of a board game, even if each of the playing pieces is tuned to a different RF frequency, interference between the different playing pieces makes it very difficult to produce an apparatus which will operate satisfactorily in practice.

US-A-5190285 describes an electronic game wherein data regarding the characteristics of a player in a video game is downloaded to the video game from a game piece to which power is supplied via a game board. Data is downloaded from the game pieces to the video game via a serial capacitive connection. US-A-5190285 still
requires power to be transferred via RF inductive coupling requiring the manufacture of coils and related components which are relatively complex and difficult to manufacture.

In one aspect, the present invention provides a data storage device for use in, for example, a games playing piece or toy, comprising:

a memory for storing data;

data reading means for causing data to be output to the memory data output when the device is supplied with power;

switching means coupled to the data output, the switching means being rendered conducting or non-conducting in dependence on the data output to the data output, and an impedance provided in the power supply path of the data storage device, the switching means being coupled in parallel with the impedance such that, in use, the impedance is short-circuited when the switching means is rendered conducting, whereby the signal supplied to the data storage device is modulated in accordance with the data read out from the memory.

The data reading means may comprise a clock generator and a counter.

In an embodiment, the data storage device derives a power supply from a supplied signal supplied by signal supplying means and may use series connected diodes to derive the power supply from the supplied signal. The power supply path may be completed by user coupling means which couples with a user to complete an electrical path to the signal supplying means. The user-coupling means
may capacitively couple to a user to complete the electrical path.

In an embodiment, the device comprises coupling means for capacitively coupling to the signal supplying means. The coupling means may comprise a first electrically conductive surface for coupling with a corresponding second conductive surface of the signal supplying means. The first conductive surface may be arranged to couple capacitively to the second conductive surface.

The switching means may comprise a transistor such as an IGFET. In an embodiment the impedance may comprise an inductance.

The present invention also provides a playing piece for use in a game, the playing piece having one or more data storage devices as set out above. The playing piece may be a card for use in a game.

The present invention also provides a toy incorporating one or more data storage devices as set out above.

The present invention also provides a games apparatus comprising one or more playing pieces as set out above and a games module having signal supplying means.

In one aspect, the present invention provides games apparatus wherein a playing piece both derives power from and communicates data with a games module by capacitive rather than inductive coupling. The use of capacitive coupling between the games module and playing piece to enable both power supply to the playing piece from the games module and data communication enables the games
apparatus to be associated with a number of playing pieces coupled to the games module by means of different sensing areas of the games module without the risk of interference between the playing pieces even when they are placed close to one another. Such apparatus is also relatively low power and, because the coupling of the playing pieces to the games module does not require the use of tuned resonant circuits, the areas via which power is supplied to and data communicated with subsidiary playing pieces and conductive connections to these areas within the games module may be relatively high resistance enabling them to be formed by conductive inks and so to be printed onto insulative materials such as paper, card or plastics materials commonly used to form playing surfaces for board games and children's toys. This makes the games apparatus both cheap and simple to manufacture.

In one aspect, the present invention provides games apparatus wherein a playing piece derives power from a games module via an electrical circuit which is completed only when a person or other body is capacitively coupled with the playing piece that is generally when the person or other body is in physical contact with or in close proximity to the playing piece. The return path to the games module may be completed by the person or other body making physical contact with or touching an area of the games module. Desirably, however, the electrical path is completed via a high impedance weak coupling which is inherently present, for example a capacitive coupling between a person and the games module due to the proximity of the person to the games module, the inevitable coupling of the person and the games module to
a local ground or earth, the coupling through a power supply of the games module to a mains electrical supply earth, coupling through a ground plane provided in the games module or any combination thereof.

Data contained in the memory of the playing piece may comprise data concerning features, strengths and information about the particular playing piece especially where, for example, the game is a role-playing or war game.

Where the games module of the gaming apparatus includes software for controlling the game, a playing piece may contain modifications or upgrades to that software so that, for example, the rules or structure of a game may be altered by the incorporation of a new playing piece into the game. This would allow, for example, additional playing pieces to be bought after the initial purchase of the game to enable the owner to upgrade the game or to add additional features to the game.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows a diagrammatic perspective view of gaming apparatus embodying the invention;

Figure 2 shows a block diagram of an embodiment of a games module of the apparatus shown in Figure 1;

Figure 3 shows a block diagram of an embodiment of a reader for the games module shown in Figure 2;

Figure 4 shows a block diagram of an embodiment of circuitry incorporated in a playing piece or component for the gaming apparatus shown in Figure 1;
Figure 5 shows a diagrammatic cross-sectional view through a component or playing piece suitable for use with the gaming apparatus shown in Figure 1;

Figures 6a to 6h show schematic electrical circuit diagrams for illustrating electrical communication between the games module and a component or playing piece;

Figure 7 illustrates diagrammatically typical data which may be stored in a memory of a playing piece or component of the apparatus shown in Figure 1;

Figure 8 shows a flow chart for illustrating the operation of the apparatus shown in Figure 1;

Figures 9 and 10 show diagrammatic cross-sectional views similar to Figure 5 of other examples of playing pieces embodying the invention; and

Figure 11 shows a very diagrammatic plan view of another example of a playing piece embodying the invention.

Referring now to Figure 1, a games apparatus 1 embodying the present invention comprises a games module 2 directly connected to a game board 3 (generally having a cardboard or plastics substrate) having a playing surface 3a divided into playing areas 30 each of which may be occupied playing pieces 4 in the form of passive, i.e. not self-powered, components. Generally the games module 2 will be provided within a housing 1a which also supports the game board 3. As shown, the playing areas 30 form a series of playing squares defining a path to be followed by the playing pieces 4. As is known in the art, each playing area 30 may contain instructions to be
carried out or questions to be answered by a person whose playing piece 4 lands on that square.

Each playing area 30 contains a sensing pad 31 in the form of an electrically conductive area. The sensing pads 31 are hidden beneath a paper or plastics top surface 3'a of the playing surface 3a and are thus shown in phantom lines.

Each sensing pad 31 is electrically coupled to a pcb (not shown) carrying the components of the games module 2 via a respective different one of a plurality of conductive tracks and an appropriate pcb connector (not shown). In the interests of simplicity, only one conductive track 31a is shown in phantom lines in Fig. 1.

The sensing pads 31 and conductive tracks are printed onto the underside of the top surface 3'a of the game board 3 by conventional printing techniques, such as screen printing of an electrically conductive material, typically a silver or carbon loaded conductive ink.

Figure 2 shows an overall block diagram of the games apparatus.

Each sensing pad 31 is connected via its conductive track 31a to a respective one of a plurality of switched input/output lines 23b of a multiplexer 23. The connection of a track 31a to its switched input/output line 23b is shown simply by line 23c in Figure 2. A multiplexed or common signal line 23a of the multiplexer 23 is connected to a reader 25.

As will be described in detail below, the reader 25 generates an hf (high frequency) signal which is supplied via the multiplexer 23 to the sensing pads 31 and when a player places and holds a playing piece 4 on a playing
area 30 modulated data is supplied via the multiplexer 23 to the reader 25 which demodulates the data and supplies data on line 25a to a games microprocessor 26 which controls game play. The reader 25 controls operation of the multiplexer 23 via bus 25b as will be described below.

The games microprocessor 26 is, in this example, associated with a random access memory 27 and a read-only memory 28 which may store game play information or data, a display 5 such as an LCD display for displaying still or video image data, a loudspeaker 6, an input/output interface 7 for, for example, coupling to a motor controller and a removable disc drive 8, for example a CD ROM drive or a bay for receiving a games cartridge. It will, of course, be appreciated that, although not shown, the display, loudspeaker, motor controller and input/output interface are connected to the microprocessor via appropriate interfaces. A user operable input device 9 in the form of a pointing device such as a mouse and/or a keyboard may also be provided.

Although not shown in Figure 2, it will be appreciated that the components of the gaming apparatus 1 will be powered by a battery or from a mains AC (Alternating Current) supply usually via an appropriate transformer. Figure 1 shows a power supply ON/OFF switch 10 of the games module 2.

Figure 3 shows an embodiment of the reader 25 which comprises a high frequency signal source or oscillator (OSC) 250. In this example, the oscillator provides a 2.81 MHz (Mega Hertz) AC signal. The output of the signal source 250 is coupled via a carrier gating circuit
251 and an impedance 252 to the multiplexed or common signal line 23a of the multiplexer 23 (not shown in Figure 3). The impedance 252 will normally be internal to the oscillator 250 but may be provided in any appropriate part or stage of the reader circuitry. The common signal line 23a is also coupled to a demodulator 253 which, in this example, is in the form of a simple diode rectifier. The demodulator 253 in combination with a subsequent low pass filter 254 enables the modulation to be recovered from an amplitude modulated signal.

The output of the low pass filter 254 is supplied via a low impedance buffer 255 to the positive input of a comparator 256. The output of the buffer 255 is also supplied via an averaging circuit 257 to the negative or inverting input of the comparator 256.

The output of the comparator 256 provides a demodulated encoded data signal to a reader microprocessor or microcontroller 259 having, in this example, a serial memory 258. The microcontroller 259 may be a PIC16C71 microcontroller while the memory 258 may be a W55206B serial RAM. The reader microcontroller 259 also controls interruption by the carrier gating circuit 251 of the oscillator 250 output to provide a signal from which the playing pieces can derive a clock signal as will be described below. It will be appreciated that memories other than serial memories may be used. Also, a state machine may be used instead of a microprocessor.

Data decoded by the reader microprocessor 259 is supplied on data line 25a to the games microprocessor 26 (see Figure 2). The symbol referenced 260 in Figure 3
represents a ground plane of the reader 25 and its role in the operation of the apparatus will be discussed below with reference to Figure 6.

The multiplexer 23 and reader 25 may have any suitable conventional form. For example, the multiplexer may be a 4051 multiplexer controlled by the reader microcontroller 259 or an array of diode switches or transmission gates switchable by the reader microcontroller 259 with the input/output lines 23b being coupled to ground when not in use. The carrier gating circuit 251 may be a logic circuit or a transistor switch which switches off the carrier signal to the RF line 23a in accordance with a signal received from the reader microcontroller 259. The averaging circuit 257 will generally consist of an averaging capacitor connected between the inverting input of the comparator 256 and ground by a transistor switch or transmission gate which is conducting while the carrier signal is present and after transients have settled but is off while the carrier is off and during carrier turn-on transients so that averaging is only carried out while there is a steady carrier signal.

As shown in Figure 4, each playing piece 4 has an electrically conductive sensing pad 41 coupled to a signal line 42 connected to a data storage device 40 carried in the playing piece 4. Power supply for the data storage device 40 is derived from an AC signal on the signal line 42 via diodes D1 and D2 coupling the signal line 42 to respective lines P1 and P2. Typically the data storage device will require a 10μA (micro amp), 2.5 volt power supply.
Typically, the area of the sensing pads 31 and 41 may be in the range of from about 25mm² to more than 1000mm² depending on the power output of the oscillator 250. The sensing pads 31 may be larger than the sensing pads 41 and may for example occupy practically the entire area of the associated playing area 30 so that precise location of a playing piece is not required. Of course, the sensing pads 31 and 41 may have any desired footprint and need not be rectangular or square.

The data storage device 40 in each playing piece has a non-volatile memory, (in this case a serial read-only memory (ROM) although any suitable form of non-volatile memory may be used), 43 coupled to an address counter 44 clocked by a clock signal derived by a clock signal generator 45 which demodulates the carrier from the oscillator signal supplied by the oscillator 250. Although not shown in Figure 4, it will be appreciated that the lines P1 and P2 are coupled so as to enable power supply to the memory 43, counter 44 and clock generator 45. A reset switch (RST) 44a is provided to reset the counter 44 when the power supply on line P1 is off for a predetermined time.

An output 43a of the memory 43 is coupled to the gate of an IGFET T having one t₁ of its source and drain electrodes coupled via line 49a to, as will be described below with reference to Figure 5, the body or casing of the playing piece and via an impedance Z to the line P2. As shown the electrode t₁ is also coupled via a resistor R to the line P2, although this resistor may be omitted if there is a voltage clamp on the power supply. The
other t₁ of the source and drain electrodes of the IGFET T is connected directly to the line P₂.

Figure 5 shows a cross-section through a typical construction for a playing piece 4. The playing piece 4 has an electrically conductive hollow body or casing 4'. The data storage device 40 shown in Figure 4 is mounted on an electrically insulating base 46 of the playing piece. The sensing pad 41 is provided as a copper layer on the exterior surface of the insulating base 46. Connection from the sensing pad 41 to the signal line 42 of the data storage device 40 is provided via a plated hole 47 through the insulating layer 46 and a wire bond 48. The line 49a from the electrode t₁ of the transistor T is electrically connected via a spring biasing member or clip 49, for example a beryllium wire, to the conductive casing 4'.

It will, of course, be appreciated that the playing pieces 4 may have any shape desired or appropriate for the game to be played using the apparatus. The casing 4' of the playing piece may be cast from metal or may be moulded from an electrically conductive polymer, for example. Because only a capacitive coupling to the player is required the playing piece may have a thin coating of paint or like material.

Figures 6a to 6g show functional circuit diagrams for illustrating how one playing piece 4 is coupled to the games module 2 in use.

When a playing piece 4 is placed on a playing area 30 (Figure 1), the sensing pad 41 of the playing piece is capacitively coupled to the sensing pad 31 of the playing area. Typically, the capacitance will be about 20pF.
(pico Farads) giving an impedance of about 2.8 kilo ohms at 2.81 MHz. A player H touching the playing piece is capacitively coupled with the electrically conductive casing 4' of the playing piece 4. The contact impedance between the player H and the conductive casing of the playing piece is represented by resistor Rc in parallel with capacitor Cc in Figures 6a to 6g. Typically, the contact impedance may be of the order of less than 100 ohms, depending upon contact pressure, moisture etc.

As will be appreciated from the above, there is only one electrically conductive track from each sensing pad 31 to the games module 2. To enable power to be derived from the oscillator 250 signal, an electrical circuit must, of course, be completed.

In the embodiment described above, the only strong signal coupling between the games module 2 and a playing piece 4 is between the two sensing pads 31 and 41. A ground (return) path is however provided via several means in differing proportions, depending upon the actual structure of the embodiment and the environment in which the apparatus is located.

Figure 6a shows an embodiment where the games module has a mains AC supply powered DC power supply unit PSU. In this example, the return path is provided by capacitive coupling (C1g in Figure 6a) of the player H to the local ground LG and a weakly coupled high impedance ground return path (Z') to the mains power supply PSU ground G. The player H has, as shown in Figure 6a, a resistance RH. The player may also have an inductive component at certain frequencies.
Figure 6b shows an embodiment where the games module is powered by a mains AC supply powered DC power supply unit PSU' incorporating a transformer TM and rectifier REC. In this case, the weakly coupled high impedance ground return path Z' is completed via the transformer interwinding capacitance C2g shown in phantom lines in Figure 6b.

Figure 6c shows an embodiment where the games module is powered by a battery BAT. In this example, the return path is provided by capacitive coupling (C1g in Figure 6c) of the player H to the local ground LG and a weakly coupled high impedance ground return path (Z') completed by capacitive coupling C3g provided by a ground plane 260 (Figure 3) of the games module. The ground plane may be provided by: a specifically provided large grounded conductive layer; grounded (that is not in use) sensing pads 31 where the number of sensing pads is large; or a combination of these. Alternatively or additionally, there may be a return path completed by capacitive coupling C4g between ground and the apparatus. Figure 6d shows a modification of the situation shown in Figure 6c. In Figure 6d there is a direct coupling of the player H to the local ground. As shown in Figure 6e, a return path may also be provided by a direct capacitive coupling Cpc between the player H and the apparatus 1.

It will be appreciated that the return paths shown in Figures 6c to 6e may occur in combination and may also occur in combination with the return paths shown in Figure 6a where the power supply is directly from the mains or in Figure 6b where the power supply is from the mains 6b via a transformer. As shown in Figure 6h, the
return electrical path may also be provided by a dipole coupling DI resulting from an electrical field radiating from the player H. This return path may be provided in combination with any one or more of the return paths described above.

The return path(s) that will be most significant in practice will depend upon the actual structure of the apparatus and the environment. It will be appreciated that many of these return paths may occur via one or more man made or naturally occurring objects in the vicinity of the gaming apparatus and that, for example, whether or not an integrated ground plane 260 is necessary will depend on the electrical structure of the apparatus, for example the integrated ground plane may not be necessary if the apparatus is mains powered.

The impedance Z' at the operating frequency given above is likely to be in the order of a kilo-ohm.

Reliance on the above types of return path is, however, not necessary. Thus, the game board 3 may be provided with an additional sensing area 300 having an electrically conductive pad 301 (Figure 1) which makes direct ohmic contact via a conductive track 301a and the pcb connector (not shown) to the negative terminal of the games module power supply so that the electrical circuit is completed when the player places his playing piece 4 on a playing area 30 and, while still in contact with the playing piece 4, touches the additional pad 301. This, as illustrated in Figure 6f, provides a direct capacitive coupling Chp where the pad 301 is hidden beneath the additional playing area 300 on the top surface 3'a of the playing surface 3a or, as illustrated in Figure 6g,
provides a direct ohmic contact Ro where the pad 301 is on the top surface 3'a of the playing surface 3.

Accordingly when the player H places and holds a playing piece 4 on a playing area 30, and the multiplexer 23 has, under control of the reader microcontroller 259, coupled the associated input/output line 23b to the common signal line 23a, a return path is completed enabling the data storage device 40 shown in Figures 4 and 5 to derive power from the carrier signal provided by the oscillator 250. Depending upon power output, the data storage device 40 capacitance and architecture, the power up time of the data storage device 40 may be as little as 100 microseconds. Power is thus supplied to the clock generator 45, address counter 44 and serial ROM 43 (Figure 4).

The clock generator 45 derives a clock signal from the periodically interrupted oscillator signal provided by the carrier gating circuit 251 under the control of the reader microprocessor 259. The address counter 44 is thus clocked to cause the data stored at each address in the memory 43 to be read out in turn and the memory 43 outputs on line 43a a high or low voltage dependent on whether a 1 or 0 is stored at the address concerned. The IGFET T is thus switched on (rendered conducting) or off depending on the voltage applied to the line 43a. Switching on of the IGFET T short circuits the impedance Z in series with the power supply to the data storage device 40, resulting in a varying load on the sensing pad 41 which amplitude modulates the carrier signal in accordance with the data read out from the serial ROM 43.
The impedance 252 must, of course, be sufficient to enable the data storage device 40 to modulate the carrier signal and will typically be in the region of 500 ohms.

The circuit arrangement shown in Figure 4 enables a higher power supply to be provided for the data storage device 40 than can be achieved with the circuit arrangement shown in Figure 4 of our International Application Publication No. WO00/31676 (International Application Number: GB 99/03948). Thus, in the circuit arrangement shown in Figure 4 of WO00/31676, the power of the data storage device 40 is reduced when the IGFET T is switched on to modulate the carrier supply. In contrast, with the circuit arrangement shown in Figure 4 the power supply to the data storage device 40 when the IGFET T is switched on is the same as when the IGFET T shown in Figure 4 of WO00/31676 is switched off while, with careful selection of the impedance Z, the power supply to the data storage device 40 can actually be increased when the IGFET T is switched off. Thus, if the player H is primarily capacitive and the impedance Z is an inductor then, a series combination of inductance and capacitance is formed and the value of the inductive impedance Z can be selected so that the inductive reactance and the capacitive reactance effectively cancel one another out so that the voltage drop across that series combination is lower than in the case when the impedance Z is short circuited by the IGFET T.

In other embodiments, the impedance Z may be a capacitor or a capacitor and resistor combination. The type of impedance I that is desirable is dependent on frequency and load with capacitance predominating at
lower frequencies. There may be some effect on sensitivity due to different people having different impedance characteristics but this should not be significant.

As illustrated by Figure 3, the modulation is recovered from the modulated carrier signal on the common signal line 23a by the demodulator 253 and, after filtering and buffering, the demodulated signal is compared with a running average of the demodulated signal by comparator 256 to provide an output representing a string of zeros and ones representing the demodulated encoded data. The demodulated encoded data is supplied to the reader microprocessor 259 (Figure 3) for supply to the games microprocessor 26 as will be discussed below with reference to Figure 8.

Figure 7 shows a possible format for data stored in the memory 43. The data comprises an identification code which identifies the particular playing piece to the games module and which is provided in a header 50 of the data. The data may also contain audio information 51 stored in any known conventional audio format (which may or may not be a compressed), video information 52 which may be, for example, MPEG encoded, data 53 identifying features or characteristics of the playing piece, data 54 regarding strength of the playing piece and information 55 such as statistics or the like. It will, of course, be appreciated that whether or not any one of the above types of data is stored in the memory 43 will be dependent upon the game for which the playing piece is designed and also on the particular playing piece.
The data stored in the memory 43 may also contain game play rules 56 and software 57 in the form of sub-routines which may be downloaded from the memory 43 into the games module and which may affect the overall operation of the game or the functionality of one or more other playing pieces in the game. The data will also contain, as is known in the art, a header cyclic redundancy check (CRC) 50a and an overall data cyclic redundancy check 50b to enable error detection.

Figure 8 shows a flow chart for illustrating the process by which the games module 2 detects and acts in accordance with the detection of playing pieces during use of the gaming apparatus shown in Figure 1.

At step S1, the reader microprocessor 259 controls the multiplexer 23 to select the next sensing pad 31. The reader microprocessor 259 then interrupts the oscillator carrier signal several times to provide a clocking signal to the data storage device 40. The oscillator carrier signal is, in this example, interrupted for approximately 3 microseconds each time. Data is clocked out of the data storage device by the pulsing of the oscillator signal. Data received by the reader microprocessor 259 from the data storage device 40 is then checked (step S2) for a leader or synchronisation section so as to confirm that data is really being transmitted and that it is not simply receiving false signals. The presence of a leader is taken to indicate that a playing piece 4 is being held on the associated playing area 30. If the synchronisation section is not received, the reader microprocessor 259 may reset the counter (by switching the carrier signal off for a
sufficiently long period to activate the reset circuit 44a) and try again. If the reader microprocessor 259 determines at step S3 that a leader has been detected, then it captures the data from the data storage device 40 at step S4 and stores it in the memory 258.

The reader microprocessor 259 then checks that the header data has been recovered correctly using the header CRC 50a and, if so, decodes the header at step S5 thereby determining the identity of the particular playing piece and also the fact that that particular playing piece is located on the playing area associated with that particular slot of the multiplexed signal.

The reader microprocessor 259 then checks the data CRC 50b. If it is correct the reader microprocessor 259 determines at step S6 whether or not the data carried by the data storage device 40 in the playing piece 4 incorporates extension data which has not previously been incorporated into the game play. Such extension data will usually be in the form of software sub-routines to be added to the software algorithms stored in the game microprocessor's memory and may represent, for example, game rules or features which only come into operation when that particular playing piece is active in the game or is present on a particular playing area 30 or may represent, for example, upgrades of the game software to add general additional features. The extension data may be any data which alters how the game is played as a result of the introduction of that particular playing piece into the game. In an extreme case, the introduction of a new playing piece or combination of pieces may provide the games microprocessor 26 with a
completely new version of the game or even a different game entirely.

If extension data is detected, then the reader microprocessor 259 extracts it from the data stream and passes it to the games microprocessor 26 so that it can execute the extended functions at step S7 thereby making the necessary modifications to the game algorithm.

If the reader microprocessor 259 determines at step S5 that there are no extensions in the data transmitted from the data storage device 40 or step S7 has already been carried out, the reader microprocessor proceeds to decode product function/response data which may comprise, for example, audio information, video information and features, strengths or information about the particular player as listed at 51 to 55 in Figure 7 and to transfer it to the games microprocessor 26 which acts appropriately (step S8).

If the decoded data storage device 40 data is audio data, then the games microprocessor 26 will cause the loudspeaker 6 to be controlled via an appropriate sound card or interface (not shown in Figure 2) to play the audio data. For example, the audio data may be a message identifying or associated with the playing piece or a characteristic tune or series of notes.

Where the decoded data is video data, then the games microprocessor 26 will cause, via an appropriate video driver, this to be displayed on the display 5. This would enable, for example, a board game to be accompanied by additional video effects or, for example, to enable a representation of the playing piece to be appropriately located on a displayed representation of the playing
board. The display 5 may also be used to display still images.

The data carried by the data storage device 40 may also include features, strengths and other information about the playing piece which the games microprocessor 26 will store in its RAM 27 in association with that playing piece and will use to determine, for example, the interaction of that playing piece with other components of the game. For example, information regarding the features and strengths of a playing piece may be used by the games microprocessor 26 to determine which of two playing pieces takes priority or has the advantage when the two playing pieces come into conflict during the game. For example, if the game is a war game or role-playing game, this information may determine whether the playing piece or an opponent on the board is victorious.

The games microprocessor 26 may perform other functions. For example, when the games microprocessor 26 determines that a playing piece has landed on a particular playing area, it may cause the loudspeaker 6 or the display 5 to provide the players with a message related to that particular playing area. This message may be independent of the particular playing piece, for example it may simply identify the playing area on which the piece has landed, or it may be dependent on the combination of the playing piece and the playing area and may be retrieved by the microprocessor from its RAM 27 or ROM 28 using the decoded identification of the playing piece. For example, when the playing piece lands on a particular playing area, the games microprocessor 26 may cause the loudspeaker 6 to issue verbal instructions or
commands to the player responsible for that playing piece, for example requesting that the player execute a forfeit, move to another playing area, pay a fine or answer a question. In the latter case, the games microprocessor may display the question on the display 5 asking the user to provide or select, using user operable means such as a mouse or other pointing device 9 (Figure 2), the correct answer to the question and may then determine the further progress of the playing piece in the game in accordance with the player's answer to the question. The type of question asked and/or the level of difficulty of the question may be determined independently of the playing piece or may be determined by the identity of the playing piece. Certain playing areas may be specific to specific playing pieces and may allow the player handling that piece to access status information. The player may be provided with headphones so that this can be done secretly. The headphones may be connectable to a headphone socket (not shown) of the games module or may be wireless headphones that communicate with the games module via wireless communications such as RF or IR (infrared) communications. The games microprocessor 26 may also be programmed to provide messages, either visually or audibly, to inform other players when a particular playing piece has made an illegal move.

Once the reader microprocessor 259 has successfully retrieved the data from a playing piece on a particular sensing area 31 it controls the multiplexer 23 (step S1) and repeats steps S2 to S8 for the next sensing area 31. If the reader microprocessor 259 does not successfully
retrieve the data it may either extend the time slot for
that sensing area and try again or may decide to leave
that sensing area and to try again later; which course of
action is selected will depend upon the speed of the game
being played.

The order in which the reader microprocessor 259
switches the input/output lines 23b will depend upon the
particular game. Where the game requires the pieces to
follow predetermined paths around the playing surface 3,
then the switched input/output lines 23b may simply be
accessed in turn. In other circumstances, the reader
microprocessor may use any known standard searching
algorithms to locate the playing pieces on the playing
surface 3.

The speed of operation of the multiplexer 23 and the
microprocessors is so much faster than the human response
time (typically 2 milliseconds may be required to
identify a playing piece) that the games module can
detect the placing of two playing pieces on the same
playing area when they are virtually simultaneously
placed on the same playing area 30 especially if the data
storage devices have different response times, as is
known in the art, enabling the data to be read from the
devices in succession.

There may, however, be occasions where two playing
pieces placed on the same playing area respond at the
same time so that the signals from the two playing pieces
interfere with one another. To avoid or reduce this
possibility, the data storage devices of the playing
pieces may implement one of a number of known anti-clash
techniques. Anti-clash techniques are described in, for example, WO97/17667, EP-A-0702323, EP-A-0702324 and US-A-5883582, the whole contents of which are hereby incorporated by reference. Thus, for example, the control logic of the data storage device (which in the example shown in Figure 4 is constituted by the counter 44 and the clock generator 45) may include, as described in WO97/17667, a pseudo random number generator so that the readout of data from the data storage device in response to the signal received from the games module is delayed by a pseudo random time determined by the generated pseudo random number. As another possibility, the control logic of the data storage device may cause the data storage device to transmit its data periodically such that the non-transmission intervals between transmissions are longer than the transmissions and are fixed for a given data storage device but vary between data storage devices due to manufacturing tolerances in the electrical components as described in US-A-5883582.

As another possibility, the control logic of the data storage device may, as described in EP-A-0702323, look for certain command codes and only allow data to be read from the games module when it identifies the correct command code. As another possibility, as described in EP-A-0702342, a tree splitting algorithm may be used to identify a single data storage device from amongst the data storage devices on a playing area.

The games microprocessor 26 can also keep track of each playing piece. For example, where the game is a game of skill which requires that a player move a piece along a particular path defined by a number of sensing
areas 31, the games microprocessor 26 can determine the speed of travel of the playing piece along that path (i.e. the time between the sensing the playing piece on successive sensing areas 31) and also the accuracy with which the playing piece follows the path by determining whether or not the playing piece actually lands on the required sensing areas in the required order. Also, if the reader microprocessor 259 continues to sense a particular sensing area until a player moves his playing piece to another sensing area, then the games microprocessor 26 can determine how long it takes a player to make a move and may penalise him if the move takes too long or if he lets go of the piece and the reader microprocessor does not sense its presence on another sensing area.

In conventional board games the fate of a playing piece that lands on a particular playing area is determined by the printed information on the playing area and/or fixed rules of the game. Apparatus embodying the invention allows, however, the games microprocessor to determine what happens to a playing piece that lands on a particular playing area so that the state of a playing area (for example whether a player receives a forfeit, reward, forfeits his turn, is eliminated from the game and so on) can be determined solely by the games microprocessor 26 in accordance with the game algorithm. This enables, for example, a particular playing area to have a different state for, for example: different playing pieces; different combinations of playing pieces; dependent upon the relative locations of particular playing pieces one or more of which may be "ghost" pieces.
that cannot be seen by the players but are simply part of the
game algorithm and may move around the board in a
manner determined by the games microprocessor; at
different times in the game; dependent on the route
and/or time taken by the playing piece to reach a
particular playing area speed; in dependence upon tasks
previously completed and/or items previously collected by
the player associated with that playing piece.

In some games the movement of the playing pieces may
be determined by an electronic dice which may be
displayed by the games module display 5 and may be
activated using the user operable means 9 (Figure 2).
Alternatively each player may be provided with a special
piece for example a wand or ring having a similar
electrical construction to the other playing pieces
described with reference to Figures 4 and 5 above so that
when the player touches a particular playing surface area
30' (Figure 1) with his wand or ring, the games
microprocessor downloads data from the wand or ring and
issues instructions via the display 5 or loudspeaker 6
(Figures 1 and 2) telling the player what he has to do
next. This has particular application for war gaming
and role playing games where the instructions may
represent a quest or goal to be achieved that depends on
the particular playing piece and its status within the
current game.

Any of the arrangements described with reference to
Figures 9 to 18b of our co-pending International
Application Publication No. W000/31676 may be modified so
that the circuit arrangement of the or each data storage
device has the circuit arrangement shown in Figure 4. The
whole contents of WO 00/31676 are hereby incorporated by reference.

In the examples described above, the playing pieces each contain a single data storage device and respond in the same way regardless of where on the conductive casing the player touches the playing piece. This need not, however, necessarily be the case. Figure 9 shows a cross-sectional view through a modified form of a playing piece. The playing piece 4 shown in Figure 9 contains two data storage devices 40' and 40" each coupled to the sensing pad 41 via a respective wire bond 48' and 48" and to a respective different one of two electrically conductive areas 4a and 4b of an otherwise electrically insulating casing 4" via a corresponding spring biasing member or clip 49' and 49". In use of such a playing piece, the data that is downloaded from the playing piece when the playing piece is activated will depend upon whether the player makes contact with the electrically conductive area 4a or the electrically conductive area 4b. As discussed above, the data storage devices 40' and 40" may have different response times so that if a player touches both electrically conductive areas 4a and 4b, the data is downloaded first from one of the data storage devices 40' and then from the other data storage device 40". It will, of course, be appreciated that a playing piece may have three or more different data storage devices each coupled to its own respective electrically conductive area with the main constraint on the number of different data storage devices being the physical size of the piece. The two data storage devices may be provided by a single device with a connection being made to
separate address sections on the data storage device by the respective wire bonds 49' and 49".

A playing piece may be designed to connect to another playing piece having its own passive data storage device so that, for example, during the course of a game, a player may acquire a weapon such as a sword or the like which, when inserted into an appropriate slot in the playing piece, can transmit its own data to the games module when the playing piece derives power from the games module. Figure 10 illustrates schematically one example of such a playing piece. In the arrangement shown in Figure 10, the main playing piece 4 differs from that shown in Figure 5 in that it has an electrically conductive side wall 4c but an electrically insulating top wall 4d formed with a recess 4e having an electrically conductive area 4f' in a mainly electrically insulating side wall 4f and an electrically conductive bottom wall 4g. The electrically conductive bottom wall 4g is coupled via a wire bond or beryllium spring clip 48a to the sensing pad 41 while the electrically conductive area 4f' is coupled via a spring clip 49a to the electrically conductive area 4c. The subsidiary playing piece 400 to be received within the recess 4e has, like the playing piece shown in Figures 4 and 5, an electrically conductive casing 400a and contains a data storage device 40a electrically coupled to the casing via a spring clip 49b and to a sensing pad 41a via a wire bond 48b. The subsidiary playing piece 400 is thus the same in structure as the playing piece 4 shown in Figures 4 and 5. When the subsidiary playing piece 400 is inserted into the recess 4e, the electrically
conductive casing 400a comes into electrical contact with
the electrically conductive area 4f' while the sensing
pad 41a comes into electrical contact with the
electrically conductive area 4g so that, effectively,
the data storage device 40a is coupled in parallel with
the data storage device 40. The two data storage devices
40 and 40a are arranged to have different response times
so that when the playing piece 4 carrying the subsidiary
playing piece 400 is held on a sensing area 31 by a
player, data is first downloaded from the data storage
device 40 and then from the data storage device 40a. The
subsidiary playing piece may contain any of the types of
data that may be stored by the data storage device 40 in
the main playing piece and so may perform any of the
functions discussed above with reference to the playing
pieces 4. As another possibility, the subsidiary playing
piece 400 may not contain its own data storage device but
may simply establish an electrical connection which enables the address counter to access areas of the memory
43 in the main playing piece which could not be accessed
absent the presence of the subsidiary playing piece 400.

It will be appreciated that the principle described
above with reference to Figure 10 can be extended to two
or more subsidiary playing pieces 400 with appropriate
modification of the main playing piece.

Figure 11 shows very schematically another example
of a playing piece for embodying the present invention.
In this example the playing piece is in the form of a
card incorporating a number of data storage devices 40 (6
in the example shown) each being electrically coupled to
its own electrically conductive area 4a to 4f on the
surface of the playing card 4. As will be appreciated, the electrical structure of the playing piece shown in Figure 11 will correspond to that shown in Figure 9 with, in the case of Figure 11, there being provided six rather than two data storage devices coupled in parallel to the sensing pad 41 (not shown in Figure 11). As explained above with reference to Figure 9, in use of this playing piece, the data that is downloaded when the playing piece is activated will depend upon the electrically conducted area 4a to 4f that the player makes contact with.

Dependent upon the game being played, the games module 2 may derive further information from the playing pieces in addition to the actual data downloaded from a data storage device. Thus, for example, the games module may be programmed to determine the duration for which a player is coupled to a playing piece by the time for which the playing piece is activated to download data. For example, the games module 2 may be programmed to identify a data download duration of less than the predetermined time as a control signal indicating an instruction from the player to the games module 2. Thus, for example, where the games apparatus is capable of playing one or more card games, then a "tap" by a player on a playing piece may indicate a "twist" instruction in a game of poker or the like whereas where the games apparatus enables the playing of fantasy or war games, then a tap by a player on a playing piece may be identified by the games apparatus as an instruction to select a weapon or movement or to indicate how many power units or armies are to be used in a particular manoeuvre. As will be understood, the games apparatus may be
programmed so as to interpret a single tap differently from a plurality of taps. It will be appreciated that, in certain games, the playing piece need not necessarily download meaningful data when activated but may merely provide a data signal to the games module indicating the duration of time for which the player is coupled to the playing piece.

In the embodiments described above, it has been assumed that the playing surface is two-dimensional. This need, however, not necessarily be the case and the apparatus may be made up of two or more levels which may be coupled capacitively in the same manner as a playing piece is coupled capacitively to the first level.

The playing surface may also itself be three-dimensional or have topography such as hills or valleys with any variations in the surface resistance due to distortion caused by, for example, vacuum forming to the required three-dimensional shape being accommodated by calibration or by appropriate distribution of the carbon when the sensing surface is formed by printing using a carbon loaded ink.

The present invention may also be used to produce drawing toys for, in particular, small children. For example, the playing pieces may be made to represent different colour pencils and when the child follows a track of sensing areas, the games microprocessor may cause the display to display a track of the same colour as the playing piece and emulating the path followed by the child with the playing piece. As another possibility, the playing pieces may be representations of animals or objects and the games microprocessor may cause
the display 5 to display a picture of the relevant animal when the child places the playing piece on a sensing area. In the above-described examples, the playing pieces generally have three-dimensional surface typography. It will, however, be appreciated that the playing pieces may be flat or planar tiles, cards or the like.

The present invention may also be applied to dolls or like toy figures so that, for example, when the child lifts the doll or contacts certain parts of the doll an audible message issues from a loudspeaker integral with the doll. In such a case, the games module 2 would normally be provided by or within the doll or toy figure and the playing pieces may be incorporated in, carried by or insertable into the doll or toy figure. The present invention may also be applied to toys that can be built up from a number of components or construction kits with, for example, the functions that the toy or construction can carry out when touched by a child being determined by the particular components which have been assembled. In this case, the games module will be provided by or within one of the components and the playing pieces may be provided by, incorporated in or insertable into others of the components.

It will be appreciated that the functions of the games and reader microprocessors may be carried out by a single microprocessor or microcontroller. However having separate games and reader microprocessors has advantages. For example, it may enable the part of the apparatus containing the games microprocessor to be separate from the part containing the reader microprocessor and, for
example, the game microprocessor and its accompanying peripherals could be a conventional personal computer or computer games machine with appropriate software.

In the examples described above, any data downloaded from a playing piece is in digital form and requires further processing. However, where the playing piece stores, for example, audio data the playing piece may itself incorporate appropriate processing means such as a digital-to-analogue converter or may have an analogue memory so that the audio data is downloaded in analogue form and may be used to drive a loudspeaker via an appropriate interface, for example. Such a playing piece would be particularly useful for toys for small children. This would increase the overall cost of the playing piece but reduce the cost of the games module because the processing components described above would not be required. Indeed because the downloaded data would be in analogue form, the multiplexing arrangement could also be omitted even where there were multiple playing areas and pieces because the analogue signal provided by different playing pieces could simply be combined so that the sounds for the different playing pieces are combined as would occur naturally if two or more people or animals made sounds at the same time.

In the majority of the examples described above, the microprocessor 26 retrieves data from the playing pieces or components. As discussed above, this data may simply identify the piece and tell the microprocessor where to find in its memory information relevant to that piece (for example audio or video information to be presented to the user of the apparatus or features or
characteristics of the piece) or the data may itself be stored in the piece. In the latter case, the playing pieces may as discussed above also incorporate software for modifying or upgrading the game being played so allowing a user to modify or completely change the game by buying new playing pieces.

The memory carried by the data storage device may be electrically programmable enabling the games module to, for example, modify the data stored in playing pieces with, for example, the addition of new pieces to the game. Thus, for example, data from a new playing piece altering the characteristics of other pieces in the game may either simply be stored in the memory of the games module or may be transferred to the playing piece itself so as to permanently change the characteristics of that playing piece. Where the memory is electronically programmable then it may be programmable by a user using conventional means so enabling, for example, a player to store his own message or game play changes. Also, the games microprocessor may store a playing piece's status or position in the game in that playing piece's data storage device so that the playing piece returns to its status or position in the next game which may be played with the same or another compatible gaming apparatus.

For ease and simplicity of manufacture the storage device 43 for all playing pieces originally provided with the game may contain data relevant to all of the different playing pieces and the passive data storage devices may be individualised to the respective playing pieces either by tailoring the conductive tracks on the data storage device or by using wire bonding so that each
playing piece is only able to access the addresses of the ROM relevant for that playing piece.

It will be appreciated from the above that the inclusion of additional impedance in the earth loop will not make any significant difference to the operation of the apparatus because the apparatus does not rely on the use of tuned resonant circuits which require a low resistance to achieve a high $Q$. This enables, as discussed above, the sensing pads 31 and associated conductive tracks to be formed as relatively high resistance printed conductive ink pads and tracks rather than metal pads and tracks and also allows the electrically conductive body of the playing piece to be formed of an electrically conductive plastics material rather than metal.

The supply of data from the data storage device 40 to the games module is in the above examples carried out synchronously with respect to the carrier signal supplied by the oscillator 250 because the data storage device 40 clock is derived from the signal provided by the oscillator 250 under the control of the reader microprocessor 259. However the data storage device 40 may be provided with a free-running clock oscillator instead of the generator 45 so that data transmission is carried out asynchronously. In such a case, the carrier gating circuit shown in Figure 3 will not be required to gate the carrier signal but may be retained to enable the reader to control the reset switch 44a to reset a playing piece’s counter 44. Synchronous transmission of the data however has advantages in that it gives the reader 25 control over the data transmission
rate so enabling high rate, reliable transmission of the data and it also avoids the need for a free-running clock oscillator on the data storage device 40, so reducing the power requirements of the data storage device.

Where a game involves only one playing piece or only a small number of playing pieces, then the microprocessor may operate on an interrupt basis and the multiplexer may be omitted.

In the above examples, the data is transmitted using amplitude modulation. However, phase (as described in WO97/23060) or other suitable modulation may be used to transmit the data.

The present invention may also be used to program the movement of toy vehicles. For example, a set of toy vehicles each provided with its own passive data storage device could be provided along with a board defining a number of different shape conductive tracks. In order to use this toy, the child moves the vehicle along the conductive track causing it to come into contact with a succession of sensing pads. This information is acquired by the games microprocessor 26 as described above and converted into control signals for controlling a motor and steering of the toy vehicle either directly via a wire link or remotely via a radio link, so that the toy vehicle is effectively programmed and will follow a path defined by the conductive track along which it was previously moved. A similar principle could be used to move pieces, for example chess pieces, round a board with the signal supplied by the games microprocessor being determined by the rules of the game. In such cases it is
of course necessary for the playing pieces to have their own power supply for powering their drive motor.

In the above described examples, the coupling between the sensing pads of the game board and the playing pieces 31 and 41 is capacitive. However, where the sensing pads can be provided on the top of the playing surface, ohmic connection between the sensing pads 31 and 41 may be used. This would enable even smaller areas of contact between the playing pieces and the game board.

Apparatus embodying the invention enables the game board to be provided as a low cost cardboard or plastics mat with, as discussed above, the sensing pads and associated conductive tracks being printed onto the underneath surface of a top printed layer of the mat. Such a mat may be flexible allowing it to be rolled up for storage, for example. Also, the individual playing pieces can be low cost and can have built in intelligence and data. Furthermore, the playing surface may have a large number of playing areas each associated with a respective sensing pad. For example where each sensing pad 31 has only one conductive track associated therewith, up to one hundred or more playing areas may be provided on a board without problems of interference between playing areas.

Game play and game play updates can, as discussed above, be stored in the playing pieces enabling a child to upgrade an existing game or toy simply by purchasing a new playing piece. Also, playing pieces are only active or "in play" when touched or contacted by a player.
The present invention may also be applied to educational games structures such as, for example, globes representing the earth or other bodies with, in this case, each sensing area being located at a specific geographical location such that when a user brings a playing piece in the form of a wand or pointing device or the like into contact with a sensing area, information regarding that geographic location is presented to the user by the games microprocessor from information stored in its memory or in the wand or pointing device. For example, the microprocessor may cause an audible message to be presented to the user via a loudspeaker giving information about that particular geographic location.

The present invention may also be applied to gaming tables and the like.

The present invention may also have applications outside the toy, educational and gaming industries. For example, the present invention may have applications in the security area where the data storage device may be associated with a document or secure product. The use of a capacitive coupling arrangement would have advantages over an inductive coupling arrangement in such circumstances because it would allow individual ones of a sheath of secure documents to be identified without interference between the data storage devices carried by different documents.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion
of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

Other modifications will be apparent to those skilled in the art.
CLAIMS:

1. A data storage device comprising:
   a memory for storing data such that each item of data has either a first or a second state and having a data output;
   power supply deriving means for deriving a power supply from a signal supplied to the data storage device by signal supplying means;
   data reading means for causing data to be supplied to the memory data output in response to the deriving means deriving a power supply from said signal;
   switching means coupled to the data output and being arranged to be rendered conducting by data having the first state and to be rendered non-conducting by data having the second state; and an impedance provided in the power supply path of the data storage device, the switching means being coupled in parallel with the impedance such that, in use, the impedance is short-circuited when the switching means is rendered conducting, whereby the signal supplied to the data storage device is modulated in accordance with data read out from the memory.

2. A device according to claim 1, wherein the data reading means comprises a clock generator and a counter.

3. A device according to claim 1 or 2, wherein the power supply deriving means comprises series connected diodes.
4. A device according to claim 1, 2 or 3, wherein the power supply deriving means comprises user coupling means for coupling to a user to complete an electrical path to the signal supplying means.

5. A device according to claim 1, 2 or 3, wherein the power supply deriving means comprises user coupling means for capacitively coupling to a user to complete an electrical path to the signal supplying means.

6. A device according to any one of the preceding claims, wherein the switching means comprises a transistor.

7. A device according to any one of the preceding claims, wherein the impedance comprises an inductance.

8. A device according to any one of claims 1 to 6, wherein the impedance comprises a capacitance.

9. A device according to any one of the preceding claims, wherein the power supply deriving means comprises coupling means for capacitively coupling to the signal supplying means.

10. A device according to any one of claims 1 to 8, wherein the coupling means comprises a first electrically conductive surface for coupling with a corresponding second electrically conductive surface of the signal
supplying means.

11. A device according to claim 10, wherein the first electrically conductive surface is arranged to couple capacitively to the second electrically conductive surface.

12. A data storage device substantially as hereinbefore described with reference to the accompanying drawings.

13. A playing piece for use in a game, the playing piece having one or more data storage devices in accordance with any one of the preceding claims.

14. A playing piece according to claim 13, wherein the playing piece is a card for use in a game.

15. A toy incorporating one or more data storage devices in accordance with any one of claims 1 to 12.

16. Games apparatus comprising one or more playing pieces in accordance with claim 13 or 14 and a games module having signal supplying means for supplying said signal to the or a playing piece.

17. Games apparatus comprising one or more playing pieces incorporating at least one data storage device in accordance with claim 10 or 11 and a games module having at least one second electrically conductive surface
arranged to couple with a first electrically conductive surface of a playing piece, and signal supplying means for supplying said signal to the at least one second electrically conductive surface.

18. Games apparatus according to claim 17, comprising a playing surface having a plurality of second electrically conductive surfaces, the signal supplying means being arranged to supply said signal to all of said second electrically conductive surfaces.

19. A games device for use with a data storage device according to any one of claims 1 to 12 or a playing piece in accordance with claim 13 or 14 arranged to supply data to the games device while in contact with a player, wherein the games device has instruction identifying means for identifying an instruction from the player in accordance with the length of time for which data is supplied to the games device from the playing piece.
FIG. 7

- HEADER 50
- HEADER CRC 50a
- AUDIO 51
- VIDEO 52
- FEATURES 53
- STRENGTHS 54
- INFORMATION 55
- PLAY RULES 56
- SOFTWARE 57
- CRC 50b
FIG. 8

START

MULTIPLEXING S1

DETECT "LEADER" S2

FOUND? S3

YES

CAPTURE DATA S4

DECODE HEADER S5

EXTENSION AVAILABLE? S6

NO

PRODUCT FUNCTION/RESPONSE S8

YES

UPDATE FUNCTION WITH NEW EXTENSIONS S7
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G11C5/14 G11C7/00 A63F3/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G11C A63F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X Patent family members are listed in annex.

* Special categories of cited documents:

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*"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

*"O" document referring to an oral disclosure, use, exhibition or other means

*"P" document published prior to the international filing date but later than the priority date claimed

1 Date of the actual completion of the international search

4 December 2001

11/12/2001 Date of mailing of the international search report

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