A user interactive video and/or audio data reproduction system such as that using data recorded on a laser readable video disc is provided with a control unit which, in response to associated programme and data and in response to user generated signals, follows a pathway through a selection tree and results in the display of video images and/or the reproduction of sounds in a manner that is determined by the user and by the programme. The control unit can be provided as a discrete unit which is attachable to and detachable from the system. The control unit can be configured so that it is functionally transparent when the source of programme and data is absent. It can thus be retained attached to the system and signalling devices such as a keypad handset can be connected to the system through the control box which acts as a serial line in such circumstances. A facility is also provided for recording the actions and timing of actions taken by the user when interactive with the system. It is convenient to use a Smartcard having either RAM or ROM capacity as the means of providing stored programme and data for use in the control unit.
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VIDEO AND/OR AUDIO DATA REPRODUCTION SYSTEM

AND CONTROLLER THEREFOR

The present invention is directed to improvements in or relating to video and/or audio reproduction systems. Especially, but not exclusively, it concerns the display of video images and the reproduction of sounds from data recorded on video disc or other high density fast access storage media.

A conventional arrangement of video system components is shown in Figure 1. In this arrangement video data recorded on a video disc 1 is read by means of a video disc player 3 and an image is displayed on the screen 5 of a video monitor 7. Many video disc players such as for example the Philips VP4XX and 3XX Series players have provision for the connection of a key pad and control unit 9. By means of this unit 9 it is possible to control operation of the video disc player so that in addition to normal play at an ordinary speed of 25 frames per second the direction of play can be reversed and/or the speed of play can be either increased or decreased for either direction of play, i.e. fast forward, fast reverse and slow motion can be
provided at the touch of a button. The video display can be suppressed so that sound only is reproduced or vice versa. Bilingual video disc recordings are also available and it is possible to select one or other of the two sound channel recordings so as to reproduce a commentary in one or other of the two languages used in the recording.

It is also common for video disc players to include an integrated text generator. It is thus possible to identify a particular frame displayed on the screen by calling for the display of the selected frame number. On press of an appropriate button the frame number and descriptive wording can be reproduced on the screen. It is also possible to control selection of the viewed frame and the video disc player can be caused to advance to another frame called up by the user. Hitherto this operation has involved the consecutive pressing of a number of numerical keys on the keypad.

To choose a particular image, set of images or sequence of images, the user can first identify the frame number by referring to a written directory or listing provided by the video disc manufacturer. Understandably this can be time consuming particularly if he wishes to view a number of different images or
sequences thereof. Once he has identified the frame number or frame numbers he then has to enter his selection by pressing a number of keys. Alternatively he may use a fast play facility to scan and search through the contents of the disc. This, however, can introduce considerable delay. An alternative to this that has emerged recently is the provision of a bar code reader that is compatible with the video player and listings which, in addition to the printed word, include bar codes for image frame selection. This operation however is not always convenient. Furthermore, should the user intend to retrace his steps there is no easy manner in which he may do this other than reversing the selections that he has made using the keypad 9. Again this involves the operation of a large number of key buttons.

By way of background in Figure 2 there is shown a schematic drawing of a video disc. Data is recorded on this disc along a spiral track which extends from a position near the inner perimeter 11 of the disc to the outer periphery. For each 360° turn there is recorded two fields, that is one frame of video data. In the track preceding the data of the first field of
each frame there is provided track identity information 13. Similar information is provided in the diametrically opposite sector 15. During play the disc is rotated at a constant angular or at a constant track velocity and the time of traverse across the leading sectors 13 and 15 just mentioned corresponds to the vertical blanking period for the video display. First field and second field data for each frame is recorded on the spiral track in diametrically opposed sectors 17 and 19 as shown. Identity information and other recording parameters are recorded on a header portion 21 of the track starting from the inner periphery 11 of the disc. The data recorded on this header portion is read during disc initialisation at the time of system startup.

It will be noted that during fast play, slow motion, still frame and direction reverse operations the rotation of the disc is maintained constant as aforesaid. During normal play the reading head is moved outwardly and radially at a constant velocity. In the case of freeze frame the recording head is displaced inwardly and radially by one track pitch so as to restart from the leading end of the same frame recording. This is repeated on each revolution whilst
freeze frame is to be maintained. For slow motion the operation is similar but after a number of rotations, e.g. three, the head is allowed to follow the next track for one rotation before again being displaced inwardly by one track pitch. For fast play at the end of each rotation the head is advanced outwardly and radially so as to jump one or more adjacent tracks. In order to reproduce frames in reverse order the recording head can be moved inwardly and radially by a distance that is an integer number of track pitches. If on each rotation it is displaced by a distance of two pitches reverse play will be at normal speed. With any greater number the reverse play is faster.

In Figure 3 there is shown a simplified and schematic outline of the main parts of a video disc player. This comprises a turntable 23 which is driven by a high speed motor and drive control 25. A laser reading head 27 is moved radially under the control of a radial drive circuit 29 and both the motor drive circuit 25 and the radial drive circuit 29 are connected to and under the control of a microcomputer or microprocessing unit 31. The electrical signal developed at the reading head 27 is passed to a video processing and display circuit 33. This separates
video and audio signals and, after appropriate processing, passes these on to the monitor 7 either directly or via a connector port 35. The video disc player 3 is also provided with a connector port 37 and a decoder 39 for receiving and passing on to the microcomputer or processor 31 signals received from a keypad handset control unit 9. On receipt of these signals the drive circuits 25 and 29 are controlled by the microcomputer or microprocessor 31 to perform selected functions such as those described above. A text generator 41 is also shown and this too is controlled by the microcomputer or microprocessor 31.

Some video disc players, notably the Philips VP4XX and 3XX Series players and Pioneer LDP 4X00 Series of players have facility for computer interaction and control. The player 3 shown in Figure 3 accordingly has an input port 43 for receiving data from a computer and also an output port 45 for relaying data to that computer.

A computer controlled video system is shown in Figure 4. In the arrangement shown a computer 47 having a display screen 49 is coupled to the video disc player
3 via input and output ports 43 and 45 just described. The user can control operation of the computer 47 and of the video disc player 3 by operation of a keyboard 51 which is connected to the computer 47.

Many additional control functions can be supported in this computer controlled system. By way of an illustration we reproduce below in Table 1 the signal codes and corresponding functions supported by the Philips VP406 Laser Vision disc drive/video disc player.

**TABLE 1**

<table>
<thead>
<tr>
<th>dec</th>
<th>hex</th>
<th>char</th>
<th>function required</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>24</td>
<td>$0</td>
<td>Replay switch disable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$1</td>
<td>Replay switch enable (default)</td>
</tr>
<tr>
<td>39</td>
<td>27</td>
<td>'</td>
<td>Eject (open the frontloader tray)</td>
</tr>
<tr>
<td>41</td>
<td>29</td>
<td>)0</td>
<td>Transmission delay off</td>
</tr>
<tr>
<td></td>
<td></td>
<td>)1</td>
<td>Transmission delay on</td>
</tr>
<tr>
<td>42</td>
<td>2A</td>
<td>*</td>
<td>Halt (still mode)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*XXXXX+yy</td>
<td>Repetitive halt and jump forward</td>
</tr>
</tbody>
</table>
- 8 -

*XXXXX-yy  Repetitive halt and jump backward

43  2B  +yy  Instant jump forward yy tracks (max 50)

5  44  2C  .0  Standby (unload)
    .1  On (load)

45  2D  -yy  Instant jump backward yy tracks (max 50)

47  2F  /  Pause (halt + all muted)

10  58  3A  :  Reset to default values

63  3F  ?F  Picture number request
    ?C  Chapter number request
    ?T  Time code request
    ?D  Disc program status request

15  ?P  Drive status request
    ?U  User code request
    ?=  Revision level request

65  41  AO  Audio-1 off
    A1  Audio-1 on (default)

20  66  42  BO  Audio-2 off
    B1  Audio-2 on (default)

67  43  CO  Chapter number display off (default)
    C1  Chapter number display on

25  68  44  DO  Picture number/time code
<table>
<thead>
<tr>
<th>Code</th>
<th>Hex</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>69</td>
<td>Picture number/time code display on</td>
</tr>
<tr>
<td>D/</td>
<td>70</td>
<td>Character display</td>
</tr>
<tr>
<td>E0</td>
<td>45</td>
<td>Video off</td>
</tr>
<tr>
<td>E1</td>
<td>69</td>
<td>Video on (default)</td>
</tr>
<tr>
<td>Fxxxxx</td>
<td>70</td>
<td>Load picture number information register</td>
</tr>
<tr>
<td>Fxxxxx</td>
<td>70</td>
<td>Load picture number stop register</td>
</tr>
<tr>
<td>FxxxxxR</td>
<td>70</td>
<td>Goto picture number then Still mode</td>
</tr>
<tr>
<td>FxxxxxN</td>
<td>70</td>
<td>Goto picture number then normal play forward</td>
</tr>
<tr>
<td>FxxxxxQ</td>
<td>72</td>
<td>Goto picture number and continue previous play mode</td>
</tr>
<tr>
<td>HO</td>
<td>48</td>
<td>Remote control not routed to computer (default)</td>
</tr>
<tr>
<td>H1</td>
<td>73</td>
<td>Remote control routed to computer</td>
</tr>
<tr>
<td>IO</td>
<td>49</td>
<td>Local front-panel buttons disabled</td>
</tr>
<tr>
<td>II</td>
<td>74</td>
<td>Local front-panel buttons enabled (default)</td>
</tr>
<tr>
<td>JO</td>
<td>4A</td>
<td>Remote control disabled for</td>
</tr>
<tr>
<td>Code</td>
<td>Value</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>76</td>
<td>4C L</td>
<td>Still forward</td>
</tr>
<tr>
<td>77</td>
<td>4D M</td>
<td>Still reverse</td>
</tr>
<tr>
<td>78</td>
<td>4E N</td>
<td>Normal play forward</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Repetitive play forward and jump forward</td>
</tr>
<tr>
<td>79</td>
<td>4F 0</td>
<td>Play reverse</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>Repetitive play reverse and jump forward</td>
</tr>
<tr>
<td>81</td>
<td>51 QxxR</td>
<td>Goto chapter and halt</td>
</tr>
<tr>
<td>83</td>
<td>53 SxxF</td>
<td>Set fast speed value, 2-40</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>Set slow speed value, 2-250</td>
</tr>
<tr>
<td>84</td>
<td>54 TxxyyN</td>
<td>Goto time code xx=min, yy=sec (yy=opt)</td>
</tr>
<tr>
<td>25</td>
<td>55 U</td>
<td>Slow motion forward</td>
</tr>
</tbody>
</table>
86 56 V Slow motion reverse  
87 57 W Fast forward  
88 58 X Clear  
90 5A Z Fast reverse  

On some of these commands the drive 3 will return a response code to the host computer 47. Codes produced for the VP406 disc drive just mentioned are reproduced in Table 2 below.

<table>
<thead>
<tr>
<th>dec</th>
<th>hex</th>
<th>response syntax</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>79</td>
<td>4F 0</td>
<td>Returned when disc-tray is opened by an F-code command, or when disc-tray is open and a command which expects a response is received</td>
</tr>
<tr>
<td>83</td>
<td>53</td>
<td>S</td>
<td>Ackn. on ON command when disc reaches correct speed</td>
</tr>
<tr>
<td>25</td>
<td>61</td>
<td>3D =x1x2x3x4x5</td>
<td>Returned after revision</td>
</tr>
<tr>
<td>70</td>
<td>46</td>
<td>Fx1x2x3x4x5</td>
<td>Returned after picture number request command (?F)</td>
</tr>
<tr>
<td>-----</td>
<td>------</td>
<td>------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>5</td>
<td>67</td>
<td>Cx1x2</td>
<td>Returned after chapter number request command (?C)</td>
</tr>
<tr>
<td>68</td>
<td>44</td>
<td>Dx1x2x3x4x5</td>
<td>Returned after disc status request command (?D)</td>
</tr>
<tr>
<td>80</td>
<td>50</td>
<td>Px1x2x3x4x5</td>
<td>Returned after drive status request command (?P)</td>
</tr>
<tr>
<td>84</td>
<td>54</td>
<td>Tx1x2x3x4</td>
<td>Returned after time code request command (?T)</td>
</tr>
<tr>
<td>85</td>
<td>55</td>
<td>UX1x2x3x4x5</td>
<td>Returned after user code request command (?U)</td>
</tr>
<tr>
<td>20</td>
<td>86</td>
<td>X</td>
<td>Returned after ?F, ?C, ?D (?T or ?U when the information is not available)</td>
</tr>
<tr>
<td>65</td>
<td>41</td>
<td>A0</td>
<td>Acknowledgment on FxxxxxR or FxxxxxxQ</td>
</tr>
</tbody>
</table>

level request (=?)

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when completed

A1 Acknowledgement on FxxxxxN when completed

5 A2 Acknowledgment on FxxxxxS when stopped

A3 Acknowledgement on Fxxxxxl when passed

A6 Acknowledgment on QxxN or QxxR when completed

10 A7 Acknowledgment on QxxyyzzS when completed

A8 Acknowledgement on TxxyyN when completed

A9 Acknowledgement on Txxyyyl when passed

AN Negative acknowledgement: picture number, chapter number or time code in error

In Tables 1 and 2 above the characters x, y, z correspond to digits which digits are represented in ASCII.
Whilst user interactivity can be enhanced using a computer the equipment is both bulky and costly. Where in the absence of a computer a keypad handset is used the interactivity between user and system is limited and in many cases involves numerous keypad operations. The user also has to have considerable guidance as to the content of the laser disc store. This can be considerable indeed because of the amount of data stored on a conventional laser video disc can amount to as many as 54,000 frames.

The present invention is directed to provide a solution to some or all the problems just mentioned.

According to a first aspect of the invention there is provided a video and/or audio data reproduction system comprising:

reading means for receiving and reading prerecorded video and/or audio data;

reproduction means for displaying video images and/or for reproducing sound as represented by such data;
selection means for controlling selection of said data to display said images and/or to reproduce said sound in a user defined sequence;

control means which is responsive to an interchangeable programme-and-data storage means, and which is responsive to signals produced in response to actions of a user, to control said selection means; and

signalling means by which said user can indicate a Menu or a Mask selection to said control said selection means.

According to a further aspect of the invention there is provided a control box for use in the system just defined. This control box comprising:

means for receiving, reading and using the interchangeable programme-and-data store aforesaid; and

means responsive to signals sent by the user to indicate either Menu or Mask selection or both.
In the drawings accompanying this specification:

Figure 1 is an illustrative drawing showing a conventional video disc system including a keypad handset control;

Figure 2 is an illustrative plan view of an optical disc;

Figure 3 is a block schematic diagram showing the main parts of a conventional video disc player;

Figure 4 is a schematic illustration of a computer controlled video disc player system;

Figures 5 to 7 are illustrative drawings showing three alternative video disc player system arrangements each in accordance with the present invention;

Figure 8 is a schematic block drawing illustrating video disc player and a signals control unit such as embodied in the system arrangements of Figures 5 and 6 above;
Figure 9 is an illustrative plan view of a Smartcard RAM/ROM memory store;

Figure 10 is a memory table for the Smartcard of the preceding figure,

Figure 11 is a schematic drawing of a sequence of data blocks in the data portion of the memory of the Smartcard of Figures 9 and 10 above;

Figures 12 to 14 show the structure of three different types of data block, i.e. for data representing, Menus, Masks and Events, respectively;

Figure 15, parts 15A and 15B is a flow chart showing the program part of the Smartcard of Figure 9;

Figures 16 and 17 illustrate Menu and Mask overlaid image displays;

Figure 18 is an illustrative plan view of a commercially available keypad handset the functions of which can be extended by this invention;
Figure 19 is an illustrative plan view of a special purpose handset;

Figure 20 is a circuit diagram of the electronic part of the handset shown in the preceding figure;

Figure 21 is a circuit diagram of a light pen circuit;

Figure 22 is an illustrative diagram indicating the storage of previous menu and mask devices;

Figure 23 is a systems block diagram showing the video player, the signals control unit and associated peripherals; and

Figures 24, parts 24A and 24B, is a circuit diagram of the signals control unit.

So that this invention might be better understood, embodiments thereof will now be described and reference will be made to the remainder of the accompanying drawings. The description that follows is given by way of example only and accordingly is not
intended to limit the scope of the invention which is defined in the claims that follow.

In Figure 5 there is shown a modified arrangement of the video disc player system shown previously in Figure 1. In this modified arrangement it will be noted that a signals control unit 53 is interposed in circuit between the keypad handset unit 9 and the video disc player 3. The signals control unit 53 is responsive to signals sent from the keypad handset unit 9 and under the control of a program and data sends control signals to the circuits of the video disc player 3. In the arrangement shown, the signals control unit 53 is provided as a separate control box and is connected to the serial interface input and output ports 43 and 45 of the video disc player 3. Alternatively it may be integrated as part of the video disc player circuitry. However, the preferred embodiment provided here as a separate unit can be connected to existing commercially available video disc players, for example the Philips VP4XX and 3XX series and Pioneer LDP 4X00 series players. Accordingly it is possible to enhance the interactivity of existing commercial players without resort to internal modification. Under the control of
- 20 -

the program and data the signals sent to the video
disc player 3 can control frame selection and, using
the text generator 41, can cause the display of
overlay menu text or Mask mode displayed text.

Furthermore, sequences of frames can be played upon
menu selection all under the control of program and
data and in response to single key operation of the
buttons of the keypad handset 9. Also by appropriate
use of the keypad handset buttons previous steps
executed can be retraced either back to a home
position or to a start position. The program and data
are stored in a read only memory (ROM) or a random
access memory (RAM). For ease of interchangeability
it is convenient to use as the RAM or ROM store a
Smartcard 55, the physical layout of which is
schematically shown in Figure 9. This Smartcard
comprises an integrated circuit memory 57 and is
communicated to the outside world by means of metal
contacts 59 located at and in the vicinity of the
leading edge of the card 55. The memory table for
this Smartcard 55 is shown in Figure 9 where it can be
seen that the memory stores both program and data.
Also shown in Figure 5 is a light pen 61 which is connected to an input of the control box 53. In the case where an image is displayed on the screen and the display is in a Mask mode, the light pen can be used to point to a specific area of the display screen 5 and, dependent on the stored data defining the Mask mapping, will then lead to a change in the display as a selected Menu, other Mask or Event corresponding to another block of the data is accessed and acted upon by the programme. In the case where the display is in a menu mode, the selected menu item (number or line) is detected and appropriate action is taken.

It will be noted that as an alternative to light pen selection, a touch sensitive panel can be located over the display screen 5 and an appropriate part of the display image pointed to by finger.

In a further alternative to the use of a light pen or touch sensitive screen the program may be arranged so that a cursor is displayed on the screen and the location of this cursor is movable in response to operations of certain of the key buttons of the keypad handset 9.
In the alternative arrangement shown in Figure 6 cursor movements are controlled by means of a mouse 63. Any other type of screen-position sensitive input means could be used.

A further alternative arrangement of the interactive video disc player system is shown in Figure 7. Here it will be noted that the keypad handset unit 7 is cordless and communicates with the video disc player by optical means. Some available video disc players are arranged to co-operate with such handsets, having an internal optical communication port. The signals for controlling the video disc player unit 3 are provided via the control box 53 which accordingly sends such signals via a connection to the serial input port 43 of the video disc player recorder unit 3.

The arrangement of video disc player unit 3 and the control box 53 is shown in Figure 8. This control box 53 has a serial input port 65 and a serial output port 67 which are connected to the serial output port 45 and the serial input port 43 of the video disc player unit 3. The control box 53 is also provided with an additional input port 69 to which it is possible to
connect the keypad handset unit 9. It also has a connector port 71 into which the Smartcard 55 can be inserted and the memory 57 of the Smartcard 55 connected to the internal circuits of the control box 53. The control box 53 may also include a power pack (not shown) for supplying power to the control box circuit elements. In some commercially available video disc players, notably in the Philips VP4XX and 3XX series, an auxiliary power output 73 is provided.

In the arrangement shown this is shown connected to a power input terminal 75 of the control box 53. The control box 53 is provided with a microprocessor component 77 which is connected to an internal RAM and ROM memory store 79. The Smartcard 55 is connected to the microprocessor component 77 via its peripheral contacts 59 and the card connector 71. Where the Smartcard 55 is of RAM type, two-way (read/write) connection can be provided between the Smartcard 55 and the microprocessor component 77. Also shown in the drawing is a signals decoder 83 which is provided between the signals input port 69 and the microprocessor component 77.
It is convenient to arrange that the control box 53 is functionally transparent when no Smartcard 55 is inserted. It is thus arranged that the control box 53 is configured as a serial line when no Smartcard 55 is present. Operations of the keypad handset 9 then result in ordinary operation.

Other peripherals such as a light-pen 61, or a bar-code reader may be connected to the video disc player unit 3 via the control box 53. This is shown in Figure 23 description of which will be given later. Programme and data will now be described.

The data is arranged in blocks B1, B2, BJ ...BN each headed by a status byte SB1, SB2, ... SBJ .... SBN as shown in Figure 11. The byte length of each block B1 to BN is dependent upon status settings, as will be described below, and accordingly the data blocks B1 to BN are of a variable length. This feature of the data is convenient since it enables a saving in data storage space. The data may be of three different types. It may correspond to a Menu, to a Mask or to a display or operation other than a Menu or a Mask, which here is termed an Event. Each block of data allows the system to perform a single operation.
Operation on a single block of Menu data results in the display of a selection menu text on the display screen 5 of the monitor 7 of the system. Operation on a single block of Mask data results in the display of Mask related text on the display screen 5 and in Mask mapping of the display. Operation upon event data results in textless display. The data structure for each Menu, Mask and Event block is shown in Figures 12 to 14.

Referring now to Figure 12, this shows the organisation of menu data. The leading byte of data, the status byte, comprises eight data bits the leading bits of which (bits 7 and 6) are indicative of data type. In this case bits 7 and 6 are 0 and 1 respectively identifying the data block as a menu data block. Bit 5 has a value 1 or 0 and indicates whether the image background to the menu text is either film or still respectively. Bit 4 relates to keypad function and is indicative of whether the keypad is to be locked or unlocked for that operation. This function will not be described further here. Bit 3 sets a delay parameter which is either on or off according to whether the data bit is 1 or 0. This is a default setting the purpose of which will be made
clear later. Bit 2 provides a setting to determine whether the background image displayed ranges over a sequence of frames either film or still dependent on the setting of status byte 5, if it is set to value 1. If single frame, it is set to 0. Bit 1 is a video control which may be set either on or off according to whether the bit value is 1 or 0, respectively. Bit 0 is a speed setting which indicates whether the speed is other than normal or normal according to bit value 1 or 0, respectively.

If the status bit 0 has a value 1, i.e. indicating a variation in display speed, the next byte (termed the speed byte) governs whether the speed is to be increased or decreased at bit 7, and in bits 6 to 0 indicates the increment by which the speed of the background image is to be incremented. If, however, the background image is to be run at normal speed, the status byte 0 is set at 0 and the speed byte is omitted.

The next byte (which is always present) governs options. Bits 7 and 6 determine whether the audio channels, audio 1 and audio 2, are on or off according to whether the bit value is 1 or 0. Where
the program is to advance in the event that no valid selection is made within a predetermined time, the length of delay is indicated by code using bits 5 and 4 of this option byte. The delay can be set for example at 0, 10, 30 or 120 seconds. The number of menu selection options can vary from between 0 and up to 10 in this implementation and the number of options is indicated by the value of the four remaining bits, bits 3 to 0 of this options byte.

In some video systems, notably the Philips players previously mentioned, it is possible to locate the menu text at a selected and not a fixed position of the screen. The position of this text is set by means of a position byte the leading four bits of which, bits 7 to 4, set the vertical position and the remaining four bits, bits 3 to 0, set the horizontal position. For players which do not support this facility, this position byte is omitted. The next two bytes specify the video disc address from which the first frame is to be selected and the next two bytes specify the address of the end frame. The end frame bytes are omitted for single frame display corresponding a setting of the status byte bit 2 of 0.
If status byte bit 3 is set at 1, i.e. delay on, the default setting, the next two bytes, termed the delay address word, provide the address of the next data block which is to be accessed on default. These two bytes are omitted if the status byte bit 3 is set at 0. The next set of bytes which may be variable in number depending on the number of options, specify the data block address which is to be accessed following option selection by the user. The next set of bytes provide character codes for the menu text. The number of bytes for coding menu text will be dependent upon the length of the message that is to be displayed. The data block is terminated by an end byte 00 (hex).

The structure of a Mask data block is shown in Figure 13. In this case, its identity as a Mask block is indicated by bits 7 and 6 of the status byte which have values 1 and 0, respectively. Each of the remaining bits 5 to 0 have the same functions as those of the menu status byte just described. As described above, there are also speed, options, start frame word, end frame word, delay address word and option address word or words. In place of a menu text there is provided a message text set of bytes and after the
end byte 00 Mask information is provided. This too is terminated by an end byte 00.

Referring to Figure 14, Event data block is identified by status byte bits 7 and 6 being both 0 valued. The indications of the remaining bits are the same as those for Mask and Menu described above with the exception that bit 3 indicates whether the displayed image comprises a sequence of frames or otherwise. A speed byte might be included dependent on status byte bit 0 being 1 or 0. There is present a start frame word of two bytes and optionally an end frame word of two bytes dependent upon status byte bit 2 being of value 1 or 0. The Event data block may also include a jump address word of two bytes if the status byte bit 3 is of value 0, i.e. the displayed image is not a sequence of frames. It is noted that if there is no jump address then the next status byte to be used is that which is immediately after the end of this information.

The text coding for Mask and Menu will now be discussed. Each byte represents a single coded text character. The text character is identified by bits 6 to 0 of the byte. For a normal text mode bit 7 of the
byte is set at 0. A repeated text mode is provided. This is coded by status byte 7 of bit value 1. In this case the text character is repeated, the number of times this character is repeated is indicated by the coding of the following byte. This is especially useful for Mask text coding where the repetition is usually extensive.

Operation of the program will now be described:

At outset the video disc player 3 is on and a video disc 1 has been loaded. Before insertion of the Smartcard 55 into the control box 53, the operation of the video disc player will appear to be normal and the video disc player 3 will respond to all normal command signals sent from the keypad handset 9. In this mode the control box 53 is acting as if it were a serial transmission line.

Reference will now be made to the program flow chart shown in Figure 15, parts 15A and 15B.

Upon insertion of the Smartcard 55 normal video play is interrupted and an initialisation routine is performed by the processor 77 under control of the
programme read from the Smartcard 55. The header information 21 on the video disc 1 is read and a data block pointer (a designated location 80 in the RAM 79) is set (step 101).

At the next step (103) it is checked whether or not the disc identity code within the header corresponds to one read from the Smartcard. The Smartcard programme and data should be suitable for the video disc player machine that is used and the Smartcard data should be data produced for managing display for a video disc 1 bearing particular recorded data. Since each recording can include up to 54,000 frames different data can be provided for managing different sub-sets of the total number of frames or, alternatively, for establishing different tree routes through sets of frames. Thus several Smartcards can correspond to a given video disc recording but would not be suitable for a different recording. Thus different Smartcards can have the same identity and can be used with the same video disc. This identity check is conducted so as to ensure that there is a proper match between video disc and Smartcard. If the disc identities recorded on disc and on Smartcard do not correspond, the processor 77 then controls
rejection of the video disc (step 105). Typically, a textual message indicating an error is displayed upon
the VDU 5. If identities match then the processor 77 proceeds to the next step (step 107) and then reads a
first block of the data which block of data is pointed by the block pointer set in step 101 (step 107).

At step 109 bit 1 of the status byte is checked and it is determined whether the video is to be on or off
i.e. whether the menu text is to be displayed with or without an image from the disc as a background. Then
at step 111 the starting frame at the video disc address specified by the two byte start frame word is
read from the player 3 and displayed on the VDU 5.

At step 113 it is determined whether or not text is to be displayed on the screen 5, i.e. it is determined
whether the data block is of type Event, Menu or Mask and if Menu or Mask the Menu or Mask message text is
passed to the video disc player 3 and, using the text generator, is displayed on the screen 5 of the monitor
7. If at the next step, step 117, it is determined that the data block is of type Mask, then a routine is entered to manage display and movement of a cursor.

The cursor may be moved by operation of the handset
keys. Alternatively if a light pen or touch sensitive screen is used, a routine is executed to manage the alternative function.

At step 121 it is determined from bit 5 of the status byte whether the background is to be a moving or a still image. If a moving image, then routine 123 is entered to manage the access and display of succeeding frames recorded on the video disc. This is conducted in a direction and at a speed determined by the data in the same block. At step 125, if a default delay has been set, bit 3 of the status byte, it is determined whether or not time out has been reached. If it has, at step 127 the block pointer is set to the default address specified by the two byte delay address word. The processor 77 then continues to execute the program from and including step 107. On the initial cycle and subsequently, if time out has not been reached, it is then determined whether the user has pressed the keypad (step 129) and at step 131 if the user has pressed a key, whether the key pressed is a valid command, i.e. whether the user has selected one of the available options indicated by menu or pressed a key with an overriding function such as step back to the preceding data address or, alternatively,
return to a predetermined display address. Preferably, when the Smartcard has a random access memory, at step 133, keypress code data and time data indicating the time that has passed between the start of menu display and menu selection by the user, are passed to the Smartcard and stored at an allocated RAM address.

At step 135 it is determined whether a menu selection has been made or whether an override function, e.g. home, back or go on, has been chosen. These functions allow the user to control his path through the menus; to step back through the preceding menus, and then forward again, or to return to the first or "home" menu.

If one of the override steps, home or back, has been chosen at step 137 it is determined which, and, if home, at step 137 the block pointer 80 is set to the home (i.e. first) menu block address and the processor returns to read the pointed block at step 107. If "back" has been selected, the current block address within the stack 81 is "popped" off the top of the stack 81 and the block pointer 80 is reset (decremented or incremented). Again, the processor
returns to step 107 to read the pointed block. Thus, by repeatedly selecting "back", the user can move deeper into the stack, back through previous operations.

Referring to Figure 22, to provide these functions, a software stack 81 comprising a plurality of contiguous memory locations (typically 20) is provided within the microprocessor working memory 79. The stack is provided as a last in first out (LIFO) stack, and the address of the next location in the stack is maintained in a stack pointer 77A (shown as a register of the processor 77, although it could be a predetermined location in the working memory 79). The block pointer 80 may be updated to contain the block address (for example, of a menu block) held within the stack location currently pointed to by the stack pointer 77A. When a new operation (for example a new menu) is selected, the corresponding block address is "pushed" onto the stack 81 (that is to say, it is loaded into the free location pointed to by the stack pointer 77A, and the value of the stack pointer 77A is correspondingly incremented to point to the following free location). The stack 81 therefore contains a historical list of the block addresses of the sequence
of operations which the user has instructed, with the stack pointer 77A containing the address of the top of the stack (i.e. that of the next free location).

If, however, a valid menu selection has been made then at step 135 control passes to step 143 and the block pointer 80 is set to the address indicated by that option address word for that selected menu option indicated by the user using the keypad handset 9. This address is pushed onto the stack 81 and the processor returns to step 107 so that the frame at this address can be read and displayed.

If at step 113 it is determined that the data block is of type Event, then the jump address, if one is present, is pushed onto the stack 81 and the pointed block is read at step 107 which follows. If no jump address has been designated, then the block pointer is incremented and data is read from the next block which follows immediately after the end of the current block.

In Figure 16 there is shown a typical menu display. This sets out the options and against each option a number corresponding to a number on the numerical
keypad which should be pressed for selection of that option.

At Figure 17 there is shown a Mask display which display includes the visible message text designated by the current data block. It will be noted that the numerals 0, 1, 2 and 3 shown in the figure are not displayed on the display screen 5 of the monitor 7, but they have been included in this figure to show how the display screen space has been mapped. The user by means of moving the cursor can point to a particular area of the screen and thereafter the numerical character corresponding to mapping of this area is identified and used as selection of the option address designated by the data in the current data block of type Mask.

In Figure 18 there is shown the layout of a commercially available video disc handset. This has some 32 key buttons which can be used during ordinary operation. The three keys, search, still and play in the bottom righthand corner are rocker switches and have different functions depending on whether they are pressed at their right extremity or at their left extremity. In this case it is determined whether the
direction of search, still frame or play is forwards or backwards.

A subset of these key buttons is used when command signalling is under Smartcard control. The handset is used to generate some twenty or so different codes to govern menu selection, overriding functions etc. The ten numeral keys 0 to 9 can be used for indicating menu option selection. In the cursor management mode mentioned step 119 the numerical keys can be reconfigured to govern the cursor movement and in this example has been so configured so as to respond to a press of the numerical key for the number 5. Other key designations are as shown in Figure 18.

In Figure 19 there is shown a dedicated purpose handset which has been designed for command signalling when the system is under the control of the control box 53 and Smartcard 55. The numerical key functions for menu selection and cursor movement are also as just described. A limited number of keys are provided, 21 in number. The touchpad for this handset is configured as a four row five column matrix. The electrical circuit for this dedicated purpose handset is shown in the next figure, Figure 20. The touchpad
row and column electrodes are connected to the input
ports of a decoder and the function selected by key
depression is indicated at the output of the decoder
on three data bit lines Q0, Q1 and Q2. The signals on
these lines correspond to the three least significant
bits B0, B1 and B2, respectively, or alternatively
the most significant two bits B3 and B4 and one other
bit labelled here DA. Discrimination of lower and
higher bit significance is provided by a signal at a
fourth output. Low and high significance are
indicated by this bit line having value 1 or 0. In
Figure 20 this line also serves as a power input. The
arrangement is convenient since this leads to a
reduction in the necessary connector pin count.

Figure 21 shows circuits employed for light pen usage.
In Figure 21 there is shown a light pen
phototransistor 151 together with its associated
biasing subcircuit 153 and amplifier subcircuit 155.
The signal from the output of this circuit is
connected to "pen" on the main circuit in Figure
24a.
Figure 23 shows a schematic (indicating the paths of data and control signals) of the system which includes video disc player 3, monitor 7, keypad/handset 9, light pen 61, control box 53 and Smartcard 55. In the circuit shown in Figure 24 provision has been made for the connection of other peripherals, in particular a bar code reader 171, a computer emulator 173 and an inline computer 175. These are all optional. The use of a bar code reader has already been described above.

Since the control box 53 is functionally transparent when no Smartcard 55 has been inserted, the functioning of the bar code reader is then normal, i.e. the bar code reader can be connected without need for disconnecting the control box 53. The functions of computer emulator 173 and inline computer 175 will not be considered here.

The circuitry of the control box 53 is shown in the circuit diagram of Figure 24, parts 24A and 24B. At the heart of the control box there is provided an HD63803R microprocessor which includes onboard RAM 79 for the stack 81. Smartcard input and outputs are connected directly to this processor. Signal bits B0, B1 and B2 or B3, B4 and DA from the handset 9 are also connected directly.
Referring to Figure 24, the gates 1A-1F and associated circuitry comprise a reset circuit for resetting the processor 77, shown here as U104. The circuit employs +12V and -12V power lines and a +5V \( V_{CC} \) logic rail, as well as a ground line. These lines may all be derived from an external source (for example, the RS232 input from the video disc player at D116) or some or all may be derived elsewhere; for example, the +5V supply may be derived as shown from a voltage regulator U108 supplied from a diode bridge, or from an external supply at D118.

The Smartcard address and data bus lines from the Smartcard port are connected to the address and data buses of the processor 77 in conventional multiplex bus fashion.

The processor control lines \( R/W \) (\( \lnot \) denotes negation), \( \lnot \)OE, \( \lnot \)CE, and \( V_{CC} \) are all supplied via a 386 tristate buffer chip, which puts these pins into the third or open state when the Smartcard is removed. Thus, the processor becomes completely inactive when the Smartcard is removed.
An RS232 routing circuit U107 (in this embodiment a 74 HCT 4053 device) is connected to the RS232 input/output ports, and controlled to either route signals directly through the control box when the Smartcard is absent, or to connect the signals as discussed above; the routing circuit U107 is shown schematically as the switches within Figure 23.

The light pen input "pen" is gated and fed to the maskable interrupt pin !IRQ of the processor. Thus, when the light pen output goes high, the processor is interrupted and executes an interrupt service routine which reads the pen position.

The video in signal from the video disc player is supplied to an LM 1881 synchronising chip which provides separated line and frame synchronisation output signals which are fed to the non-maskable interrupt pin, and port 2, of the processor. These inputs may also be overridden by externally supplied line and frame synchronisation signals from other types of video signal source. A serial input buffer chip comprises four serial input buffers 2A, 2B, 2C, 2D. A DTR printer control signal is provided by transistor T3.
As shown above the existing image store is controlled from a simple handset by a user and results in the delivery of a sequence of images determined by the user from a predetermined set held in the image store.

A further feature of the whole system just described, is that, by the use of particular Smartcards, in conjunction with appropriate programming structures, the keypad actions of the user and the time delay between these actions can be recorded on the card and subsequently used in various ways to monitor the performance of the individual user.

The internal memory 79 of the control box has sufficient capacity in the stack 81 to store details of the last twenty key presses and these can be recalled in reverse order, this allowing the user to "step back" through the path that he has taken.
CLAIMS:

1. A video and/or audio data reproduction system comprising:

5 reading means for receiving and reading prerecorded video and/or audio data;

reproduction means for displaying video images and/or for reproducing sound as represented by such data;

selection means for controlling selection of said data to display said images and/or to reproduce said sound in a user defined sequence;

15 control means which is responsive to an interchangeable programme-and-data storage means, and which is responsive to signals produced in response to actions of a user, to control said selection means; and

20 signalling means by which said user can indicate a Menu or a Mask selection to so control said selection means.
2. A system as claimed in claim 1 wherein said control means has facility for receiving and reading a Smartcard store on which is recorded both programme and data for controlling said selection and for determining data sequences dependant upon the actions of the user.

3. A system as claimed in either of claims 1 or 2 wherein said control means is attachable to and detachable from said system.

4. A system as claimed in claim 3 wherein said control means has facility for receiving signals directly from said signalling means.

5. A system as claimed in claims 2 and 4 wherein said control means is functionally transparent to, and can act as a serial line for, said signalling means, in the circumstances that no Smartcard is received therein.

6. A system as claimed in claim 2 or any claim dependant therefrom wherein said control means in response to said programme is operable to compare
identities of the interchangeable programme-and-data storage means and Smartcard.

7. A system as claimed in any preceding claim having facility for recording user actions on said programme-and-data storage means.

8. A system as claimed in claim 7 having facility for recording on programme-and-data storage means the times of, or time intervals between, user actions.

9. A system as claimed in any of the preceding claims wherein said control means has facility for recording data representing actions taken by said user and for retracing those actions when signalled and requested by said user using said signalling means.

10. A system as claimed in any of the preceding claims wherein said system comprises:

a video disc player as reading means, reproduction means, and selection means.
11. A system as claimed in claim 10 wherein said signalling means comprises a keypad handset.

12. A system as claimed in either of claims 10 or 11 wherein said signalling means comprises a light-pen.

13. A control box for the system as claimed in any one of the preceding claims, which control box comprises:

means for receiving, reading and using the interchangeable programme-and-data store aforesaid; and

means responsive to signals sent by the user to indicate either Menu or Mask selection or both.

14. A control box as claimed in claim 13 having means for receiving a Smartcard programme and data store.

15. Use of a Smartcard in the system as claimed in claim 2, or in any claim depending therefrom, to control selection of data from pre-recorded data in response to Menu or Mask selection by the user or in
response to overriding function selection by the user.

16. A video reproduction system which comprises a video store including a multiplicity of video images, means for storing a plurality of addresses indicating the position of desired images within said store, and means for selecting a given said image address, the means for selecting comprising means for displaying selection information on a visual display, and means for accepting a user input specifying an item of said selection information.

17. Apparatus according to claim 16, wherein said selection information comprises a menu display indicating a plurality of options.

18. Apparatus according to claim 16 or claim 17, wherein said selection information comprises a pictorial display, different areas of which correspond to different selections.

19. Apparatus according to any one of claims 16 to 18, further comprising means for storing a plurality
of preceding selections, and means for recalling said stored preceding selections.
Menu

Status Byte

<table>
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<tr>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
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<th>0</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>FILM</td>
<td>Kypd Lock</td>
<td>Delay on</td>
<td>Range</td>
<td>Video on</td>
<td>Vary Spd</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>Unlocked</td>
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<td>Single</td>
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<td>Norm Spd</td>
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Options Byte

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<td>Number of Options</td>
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<td></td>
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<tr>
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<td>off</td>
<td>0,1,2,3</td>
<td>0...10</td>
<td></td>
<td></td>
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Position Byte

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<th>0</th>
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<tbody>
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<td>V position for screen</td>
<td>H position for screen</td>
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<td></td>
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<td></td>
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</tbody>
</table>

Note Position is in Characters if function supported by player

Start Frame Word

Start Frame (2 Bytes)

End Frame Word

End Frame (2 Bytes)

Delay Addr Word

Delay Address (2 Bytes)

Option Addr Word

Option 1..9, 0 Address (2n Bytes)

Menu Text

Menu Text Coded

End Byte

00

Text Coding: (Text is "7" bits + Coding Bit)

7 6 5 4 3 2 1 0
0 7 bit text character Normal Text Mode

7 6 5 4 3 2 1 0 7 6 5 4 3 2 1 0
1 7 bit text character No. of times char repeated Repeated Text

e.g. 30 8D 04 is equivalent to 30 0D 0D 0D 0D

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Masks

Status Byte

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<td>Kypd Lock</td>
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<td>Range</td>
<td>Video on</td>
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Speed Byte

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<tr>
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Options Byte

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<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
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<td></td>
<td></td>
<td></td>
<td>=1</td>
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<td></td>
</tr>
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</table>

Start Frame

End Frame

Delay Addr

Delay Address (2 Bytes)

Option Addr

Option 1...9, 0 Address (2n Bytes)

Message Text

Message Text Coded

End Byte

Mask Data

Mask Coded

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Figure 13

SUBSTITUTE SHEET
Event

<table>
<thead>
<tr>
<th>Status Byte</th>
<th>FILM</th>
<th>Kypd Lock</th>
<th>Seq Frm</th>
<th>Range</th>
<th>Video on</th>
<th>Vary Spd</th>
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<tbody>
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<table>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

if Status B0=1

Start Frame
Word

End Frame
Word

if statusByte B2=1

Jump Addr
Word

if statusByte B3=0

Figure 14

8/19
This is a MENU
Do you wish to see
Room 1 ? Select 1
Room 2 ? Select 2
Room 3 ? Select 3

Figure 16

This is a MASK

Please place cursor over a room you wish to view

Figure 17

12/19
Figure 18
Figure 19
Keypad Circuit Diagram

Decoder 74C922

Vcc2=4.4v

B0/B3
B1/B4
B2/DA

1=POWER+
LOWBIT:
0=HIGHBIT

Figure 20

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