(54) Title: DATA STORE CONNECTION

(57) Abstract

Apparatus for connecting an additional data storage device to a computer port, such as a printer port, that is not necessarily adapted for connection to a data storage device. An interface circuit comprises means for reading stored multibit data to a memory device and reading the multibit data from the memory device in a sequence of data segments that can be handled by a lesser number of data lines. In the case of standard parallel printer ports the data and control lines may be switched to carry respective control signals and data.

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DATA STORE CONNECTION

This invention relates to connection of data storage systems to computers and in particular, but not exclusively, to connection of hard disk drives to microcomputers.

With the expansion of use of microcomputers and integrated computer systems for business and home use there is a growing demand for transportable data storage devices with greater capacity than floppy disks, and in particular for transportable hard disks. It would be convenient to be able to simply disconnect a hard disk from a computer at one location and be able to connect it to any other computer with a compatible operating system. However at present there is no simple way of providing this facility without specialised modification of the structure of the computers between which disk transfer is desired.

The present invention is directed towards providing simple connection of data storage devices such as hard disks through standard ports not necessarily originally configured for connection to such a data storage device.

Accordingly the invention provides apparatus for connecting a data storage device to a computer port, the data storage device having a greater bit multiplicity than the input lines available on the port, the apparatus comprising means for reading stored multibit data to a memory device and means for reading the multibit data from the memory device in a sequence of lesser bit number data segments for input along available input lines of the port.
Preferably the apparatus also includes means for outputting data along output lines of the port in lesser bit number data segments and means for combining the output data segments into said multibit format.

The invention also provides a method of connecting a data storage device to a computer connection port when the data storage device has a greater number of output lines than the input lines available on the port, the method comprising dividing the data into a series of data segments of number at most equal to the number of lines available and sequentially reading the data segments into the computer via available lines.

Preferably data is output from the computer in a series of four bit nibbles and combined to correspond to the bit format of the storage device.

The invention is now described by way of example with reference to the accompanying drawing in which Figure 1 shows a block diagram of an interface circuit according to a preferred embodiment of the invention.

One of the principal objects of the present invention is to provide the ability to simply plug in an additional hard disk drive to existing computers, especially microcomputers, or PC's without requiring structural modification of the computer hardware. One way to achieve this is to connect the disk drive through a standard serial interface, but this would result in very slow communication from computer to disk drive. On other computers there may be free parallel ports, but the configuration of these may vary from computer to computer. In the preferred embodiment of the
invention it is therefore proposed to utilise a parallel printer interface port that is of standard configuration and is provided on virtually every PC, and indeed on many other computers. Figure 1 shows schematically an embodiment of an interface circuit according to the invention designed to overcome the problem that a parallel printer port does not have the appropriate lines for connection to a hard disk drive. The left hand side of Figure 1 shows the standard parallel printer port lines which are: eight output data lines 1 for communicating from computer to printer, four control lines 2 for communicating instructions from the computer to the printer and five status or reply lines 3 along which the printer provides status signals to the computer. A 16 bit disk drive, the output interface of which is represented by the right hand side of Figure 1, communicates to a computer along 16 bit bidirectional lines and requires further status and control lines.

In the embodiment four of the status lines 3 of the parallel printer interface port, which permit communication to the computer, are utilised as the input for all 16 lines from the disk to the computer and the four control lines 2 are used for all 16 bits from computer back to the disk drive. The 8 bit parallel printer port data lines 1 from the computer are used to send controls from the computer to the interface and disk drive.

In order to handle the 16 bit lines from the disk the lines are read from a 16 bit bidirectional data bus 20 from the disk interface directly into four parallel buffers 4 which are adapted to clean the signals, and from each of the buffers 4 directly into a respective storage latch 6. Four lines run from the bus 20 to each of the buffers 4 and four
lines from each buffer 4 to its respective latch 6. A read clock 5 controls the series of latches 6 to read out the four lines from each of the latches in turn so that instead of 16 parallel bit lines there is a series of four 4 bit nibbles (each nibble originating from one of the latches 6) entering a multiplexer 7. At the multiplexer each nibble is given an address by a 2 binary bit nibble addresser 21. The addressed nibbles are then output on four lines to a driver 8 where the signals are again conditioned before being input to the computer along the status lines 3.

Writing to the disk is achieved by outputting data in 4 bit nibbles along control lines 2 into a buffer 9 where the signal is cleaned before being output on four lines to a multiplexer 10. The 16 bit word required by the disk drive is assembled by outputting the nibbles to each of four 4 bit memory latches 11 in sequence, each nibble being given a nibble address by nibble addresser 22. A nibble clock 12 latches each respective 4 bit nibble in turn in accordance with its address out of the latches 11 so that the four nibbles are simultaneously output first to a corresponding driver 13 for pulse processing and then the 16 bit word is output on 16 lines (four from each driver 13) to the disk data bus 20.

In addition to the provision of the nibble interface the operating system (for example for most current PC's DOS) software of the computer is modified so that it can recognise that a disk drive is connected to the parallel printer port. For example in a DOS system the configuration file CONFIG.SYS that is stored on the system disk or bootable drive can be modified by inclusion of a driver program that controls the picking up and sending out of data.
in nibbles that are handled by the interface. Similar modifications may be made to other operating systems.

The 8 bit data lines 1 are connected to control the interface via the modified system software. The control signals are supplied on lines 1 to a buffer 23, also for signal cleaning, and via eight lines and a driver 25 to the disk drive. Three of the eight lines 1 are used to control the addresses to the disk drive and two of these lines also control the nibble addressers 21 and 22. A fourth line controls the nibble clock 12, fifth and sixth lines control the read and write clocks 5 and 24 and seventh and eighth lines control the disk drive.

Read heads on hard disks are at present generally of a mechanical nature, and it is not possible to simply control the read rate, with the result that data input to the data bus 20 may be too fast to be read by the computer via the parallel port. For this reason it is necessary to have some means for controlling the read rate of data from the disk, and for this purpose a cache memory buffer is conveniently used. The cache memory buffer may be fabricated along with the hard disk or be part of the interface circuit.

The interface circuit may be made to be compatible with existing hard disk packages and is preferably packaged with a hard disk. For transportation safety it is desirable for the package to have a good shock rating so that handling and even dropping does not cause damage. For this purpose the disk and interface may be mounted in a package using shock absorbing mountings, for example resilient mountings. A compact package is also desirable from the ease of transportation point of view but relative confinement also
presents heating problems. A particularly preferred package includes a liquid heat sink such as a fluorinated liquid heat sink which has high thermal convection properties. An added advantage of the liquid heat sink is that it also provides additional shock absorbancy.

The embodiment described may be modified for use with differing numbers of data storage lines and port lines, with different bit segment sizes. In the extreme case the data may be input serially a bit at a time. Alternative data storage devices other than hard disks may also be connected in an analogous manner. The demountable, compact nature of the system is of significant importance not only for flexibility and transportation but also for security purposes enabling simple demounting of sensitive information and for establishment of back up records.
CLAMMS

1. Apparatus for connecting a data storage device to a computer port, the data storage device having a greater bit multiplicity than the input lines available on the port, the apparatus comprising means for reading stored multibit data to a memory device and means for reading the multibit data from the memory device in a sequence of lesser bit number data segments for input along available input lines of the port.

2. Apparatus according to claim 1 further comprising means for outputting data along output control lines of the port in lesser bit number data segments and means for combining the output data segments to said multibit format.

3. Apparatus according to claim 2 in which the means for combining the output data segments comprises a second memory device.

4. Apparatus according to claim 2 in which the means for combining the output data segments comprises a plurality of parallel memories.

5. Apparatus according to any preceding claim in which the memory device comprises a plurality of parallel memories.

6. Apparatus according to any preceding claim in which the means for reading the stored data comprises means for enabling control of the read rate.
7. Apparatus according to claim 4 in which the means for enabling control of the read rate comprises a cache memory.

8. Apparatus according to any preceding claim in which the port is a parallel printer port.

9. Apparatus according to claim 8 in which the nibbles are input along lines adapted to be connected to the status lines of the port.

10. Apparatus according to claim 8 or claim 9 in which data segments are output to the storage device along lines adapted to be connected to the control lines of the port.

11. Apparatus according to any of claims 8 to 10 in which software control of the storage device and apparatus are output along lines adapted to be connected to the data lines of the port.

12. Apparatus according to any preceding claim in which the storage device comprises a hard disk.

13. Apparatus according to any preceding claim in which the data is 16 bits and the data segments are 4 bit nibbles.

14. A method of connecting a data storage device to a computer connection port when the data storage device has a greater number of output lines than the input lines available on the port, the method comprising dividing the data into a series of data segments of number at most equal to the number of lines available and sequentially reading the data segments into the computer via available input lines.
15. A method according to claim 14 in which data is output from the computer in a series of data segments and combined to correspond to the bit format of the storage device.

16. A method to claim 14 or claim 15 in which the port is a parallel printer port and the data segments are input via the parallel printer port status lines.

17. A method according to any of claims 14 to 16 in which software control of the apparatus and storage device is output along data lines of the parallel printer port.

18. A method according to any of claims 14 to 17 in which data segments are output via the control lines of the parallel printer port.