

USE OF AT-BUS HARD DISK DRIVE IN A HAND-HELD DATA COLLECTOR

S.D. Kao and G.J. Jan

Department of Electrical Engineering, National Taiwan University,
Taipei, Taiwan, Republic of China

Abstract : A Microprocessor-Based Hand-Held Data Collector using an AT bus interface hard disk (HD) has been developed. It can capture data into RAM and then self-save that data directly onto a hard disk. After saving, the raw data can be accessed by the PC via an AT bus interface for future processing. This approach offers the possibility to develop a low cost, high speed, large capacity and flexible hand-held data recorder.

Introduction : It is of considerably important interest to develop a portable, long time and high performance data collector for the physiological network[1]. The present day data recording system for the biomedical field uses magnetic tape and/or the electronic memory[1-3]. The disadvantage of the magnetic tape is the limitation of the bandwidth due to the low tape speed, and the too few input/output channels. As well, electronic memory, such as RAM, has a power stability problem. Power loss will lose of data during data recording.

The small size, large capacity memory and low power consumption of the HD has rapidly improved due to the engineering and technological growth in recent years. There are many kinds of interface to the hard disk device(HDD). However, the AT bus is an easy and simple way to control the HDD. The AT bus interface is a standard interface which is documented by the so called intelligent drive electronics(IDE) interface. The IDE drives also have power-consumption advantages over other drives[4].

The purpose of our research is to design and develop a hand-held data collector base on IDE HDD which is used in the physiological field or other related applications where such functions are needed. The design concept and development, as well as the signal recording test, are described in this manuscript.

System design concept and architecture : The major design concept of the hand-held data recorder is its small size and compact hard disk

with IDE interfacing and a single chip microprocessor-based controller. A single chip microprocessor, Intel 8032, is used in this portable data collection instrument. The purpose of the electronic data collector is to provide the 8 channel, 8 bit data length ADC with input to DAS. The data is stored in RAM and then auto-saved onto HD for long time data storage.

In order to communicate with an external PC, a homemade IDE HDD control card was used. The control card uses the PC I/O port address 360(hex)-367(hex), 36e(hex) and interrupt 11, which does not affect the original PC's HDD operation. The IDE interface bus can provide a higher data communicate rate than the RS-232 serial I/O, and does not increase the complexity of the data collector. The stored data may be accessed and processed by the host PC at anytime later.

For greater convenience a 4x4 input keyboard has been incorporated. This allows data I/O channel and function selection. An LCD display is used to indicate real time data in graph form.

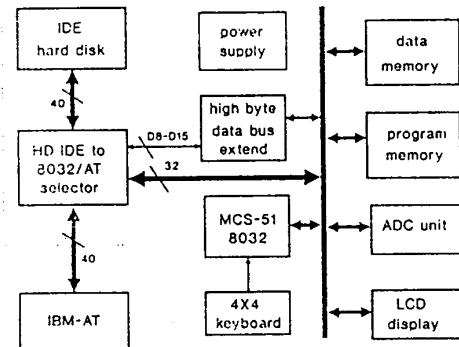


Fig.1 System function block diagram.

Hardware system: The portable section of our system is within the dashed boundary line, as shown in Fig.1. An Intel 8032 microprocessor used as a controller for the HDD Hand-held data recorder. An external memory, consisting

of 32 Kbytes RAM and 16 Kbytes ROM, was built-in for data storage memory and program memory. Analog-digital conversion(ADC) is performed by an ADC-0809, an 8 channel, 8 bit data length 100 us converter. Because the analog input of the ADC-0809 is 0-5V, the input signal level needs to be shifted by the level shifter, an LM324. A 4x4 keyboard is used for I/O initialization setting, LCD display control mode and I/O channel selection. A 64X128 dots matrix black/white LCD is used to display the message and/or trend graphics. As the IDE interface bus has a reserved 16 bit data I/O bus for the HD, it is necessary to add this to the data bus extension for the high-byte (D8-D15). Two 74HC573 data latch IC's were used as a high-byte I/O temporary register. The function of the HD IDE selector is to choose interfacing with the PC/AT ,or, the 8032 for data access. For the PC data access, it is a simple matter to make a PC IDE HDD control card. Requirements include a bus buffer and an address decoder. Most of the IDE signals can connected directly to the AT I/O channels[5]. We used a 2.5 inch and AT-bus HD with 40 Mbytes of memory. Make, 'Conner' model CP2044PK. The dimensions and weight for our system are 140x110x50 mm and 865 g.

Software concept and development:Two program are needed, one is for 8032 data capture and the other program for PC data readback. HDD sector 0 has been defined as a mail box for data information, include the data length ,channel number and sampling rate. Whenever system is powered on the user must set up the ADC sampling rate, channel number and the data length. This initializing information will self-save onto HDD sector 0. In order to save power and reduce HDD read/write time, two memory banks are used from the 32 Kbyte RAM memory block. If raw data is initially stored in memory bank number one which then becomes full, the O/S will swap over to memory bank number two for further data collection ,and, the data on bank one is saved onto HD automatically. When bank two is full the O/S reverts to bank one again. This cycle continues until the data collection is complete. When the HDD has no task to perform it will default to an idle mode, such that power consumption is a bare minimum.

Results and discussion: A four channels ADC input signal were sampling with frequency 500Hz, was saved onto HD. The raw data stored on HDD data recorder was accessed by PC and displayed on a VGA monitor. The data trend signal was then printed on an X,Y plotter. Fig.2.

Our experiment results showed that the hand-held data recorder promised to be useful as a long-time data saver. It provided high performance with small portable features and the ability to communicate directly with the host PC for post data processing. This hard disk device is a very reasonably priced piece of electronic equipment which may be used to record physiological signals, such as EKG, EEG or EMG. The recorder is especially useful as a long time data collector.

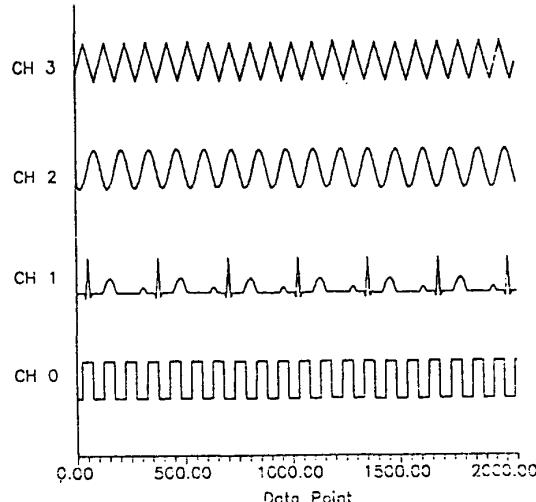


Fig.2 Shows the 500Hz sample rate signal which was recorded using the portable HD recorder and plack-back to a plotter.

References:

- [1]. Hung, X., et al., :"Use of dynamic RAM in a portable data recorder", Electronic letters, 1992,28, pp.1871-1872
- [2] Dahnoun,N. et al., "Portable directional ultrasonic Doppler blood velocimeter for ambulatory use" ,Med. Biol. Eng. Comput. ,1990,28, pp.474-482
- [3] Salvador,C.H. et al., "Recording of physiological signals with domestic videotape storage", Med. Biol. Eng. Comput., 1991,29,pp.155-158
- [4] Alford , R . C . , "The IDE hard disk drive interface", Byte, 1991, March, pp.317-323 .