SCIENTIFIC APPLICATIONS OF THE APPLE GAME PORT
PART III
by Kenneth Ratzlaff*

In previous notes, we looked at methods of gathering data using the Apple and Commodore 64 game ports. The analog-to-digital converter in each case measures resistance and we noted some useful resistive transducers, particularly the thermistor, the photoconductive cell, and the potentiometer.

A Project SERAPHIM disk entitled "Data Collection/Retrieval System" developed by John K. Estell and John W. Moore is available. This disk desribes how the Apple II Game I/O port can be used to collect data, store it on floppy disk and retrieve it for analysis. Software for data collection, retrieval, and graphical and numerical display is contained on the disk. A tutorial on the disk gives an overview of the system and contains instructions for using the game port, building an interface cable and using the software routines. The necessary hardware can be purchased for under $20 in local electronics stores. The disk can be purchased for $4 from Project SERAPHIM (Department of Chemistry, Eastern Michigan University, Ypsilanti, MI 48197; (313) 487-0368) and will be available early in 1985.

Robert F. Tinker and Diana Malone have developed an experiment package entitled "Experiments in Chemistry". The kit consists of hardware and software which can be used with an Apple II, II+ or IIe having 48k or more of core. Fifteen experiments have been developed using the package which involve temperature measurements (enthalpic titrations, cooling curves and measuring the specific heat of metals), pH measurements or titrations, EMF measurements or potenciometric titrations. Additional experiments can be devised by the user. The software is menu driven and interactive. Graphs and tables can be generated. First and second derivatives of titration curves can be obtained. The complete package can be purchased from HRM software for $335 (175 Tompkins Avenue, Pleasantville, NY 10570; (800) 431-2050). A demonstration disk is available to those contemplating purchase.

In this final note, we want to look at some experiments which use the game port to teach some fundamentals of data acquisition. In this regard, there are two general principles to be demonstrated: the effects of aliasing and of resolution.

ALIASING. The problem of aliasing the signal is best understood when one attempts either to sample a sinusoidal signal or to sample a dc signal when sinusoidal noise is present. The sampling theorem states that a signal must be sampled at the rate of at least twice the highest frequency present. Failure to heed this rule will lead to the appearance of a component of the signal with a frequency which is an integral fraction of the actual frequency.

We can demonstrate this phenomenon with the game port by using a potentiometer as the pivot of a pendulum as outlined in the last installment. If the pendulum is allowed to swing, the resistance will vary sinusoidally with time. Set up the pendulum so that the period is short, about 1 second. If you sample several times per second and plot the results, a sine wave will result with the same period that you observe visually.

To demonstrate an aliased signal, repeat the experiment a large number of times, each time increasing (with a FOR-NEXT wait loop) the time between acquisitions. When the acquisition rate is equal to the period of the pendulum, the readings will be constant, and as the acquisition rate is slowed even further, a sine wave will reappear, but at a lower frequency.

In this experiment, the objective is to measure the frequency and amplitude of the sine wave, but the aliased signal has the wrong frequency even while having the appearance of being correct. A similar experiment with a voltage-input ADC might entail acquisition of a spectrum from a spectrophotometer when a 60 Hz noise signal is super-imposed on the signal. If an analog filter is not used to remove the 60 Hz noise, it could very easily appear as a much lower frequency sine wave superimposed on the spectrum. The effect of the acquisition of gaussian-shaped peaks is similar but is less intuitive and will not be discussed here.

RESOLUTION. The resolution must be controlled in a manner similar to the scale on a strip-chart recorder. The signal span should be from nearly zero to nearly full-scale. If not, precision is lost.

The measurement of heat transfer is a simple experiment which simulates a first-order process. Take a beaker of cool water stirred by magnetic stirrer with a thermistor to measure the temperature. Make a "hot finger" by blowing steam into a test tube which is partially submersed in the beaker. The temperature of the water will rise to a steady-state temperature.

The resolution can be reduced by at least two methods. One method would be to begin with quite warm water so that the span is only a few degrees when the thermistor is set for about 100 degrees full scale. The second method would be to use a different thermistor so that full scale would be much greater than the temperature range of the experiment. If the signal range is small, it becomes easy to show that precision is lost.

*Instrument Design Laboratory
Chemistry Department
University of Kansas
Lawrence, KS 60045

AN INEXPENSIVE WORD PROCESSING SYSTEM
by James D. Beck*

If you would like to do word processing at home with letter-quality copy, but don't want to spend a lot of money, consider this system: a Radio Shack Color Computer, the Telewriter-64 word processing program, and the Brother Correctronic 50 electronic typewriter. The entire system can be obtained for about $800. I have been using this combination for about six months and am very pleased with the results.

The Brother typewriter produces beautiful copy using interchangeable daisywheels which are available in several type styles. Although quite slow as a printer (12 cps), it has the advantage of doing double duty as an excellent electronic typewriter with features such as full line correction, variable pitch, and a repeat key. It can be purchased at discount stores for about $300. Add $150 for the computer interface. Brother will tell you how to make a cable to connect the interface to the Color Computer (parts are available at Radio Shack for a few dollars).

Telewriter-64, although inexpensive, is a good word processor for home use. Cost is $50 on cassette or $60 on disk from Cognitec, 704 N. Nob Avenue, Del Mar, CA 92104. Features include upper and lower case in several display modes, simple but effective editing capability, right justification, and the capability of using embedded format and control codes. It is menu-driven and simple to learn. The tape version operates surprisingly fast and has been very reliable. Used with the 64K Color Computer, you have about 40K left for text storage.

This system gives you a good small home computer with a good BASIC interpreter and color, sound, and graphics capability. It operates with any color or black-and-white TV (I use a $50, 12-inch black-and-white for word processing). There is a fairly extensive collection of games, educational programs, and general purpose software available for the Color Computer. With this system you also have an electronic typewriter which can be used independently of the computer, without even disconnecting the interface. I especially like being able to correct mistakes in the final copy, using the typewriter mode. This is usually faster than going back to the word processor file, making the correction, then printing the document again.

*Department of Chemistry
Virginia State University
Petersburg, VA 28803

SERAPHIM/CCCE WORKSHOPS

The series of one day intensive workshops for high school chemistry teachers is off to a flying start with at least sixteen already scheduled and many more pending confirmation of dates. In order to improve flexibility there are now two sets of commercial software available and arrangements are being made for a third. Because of the increased number of workshops, responsibility for scheduling and distributing materials will now be split between the eastern and western halves of the country, using the Mississippi River as the dividing line. The regional coordinators are:

ACS-CCCE Teacher Workshop Coordinator EAST:

James H. Nelson
Harriton High School
Rosemont, PA 19010
(215) 525-1270

ACS-CCCE Teacher Workshop Conference WEST:

Ken Hartman
Ames High School
Ames, IA 50010
(515) 232-8440, ext. 228

Both Jim and Ken have had extensive experience in organizing and presenting workshops. Most recently, Jim was responsible for the sessions on teaching with computers given to the 1984 Presidential Award Teachers at the NSTA sponsored workshops last summer. Ken was very influential in the design of the workshop kits assembled last summer during the SERAPHIM Workshop Leader Training Program. For details concerning upcoming workshops see the Workshops, Meetings, Conferences and Courses section of this Newsletter. If you have questions about future workshops, contact Jim if you live in the East, and Ken if you live in the West.