Scientific Applications of the Apple Game Port
by Kenneth Ratzlaff*

Part I. The Basis of the Measurement

Understanding the fundamentals of data acquisition and control is an important part of learning about the use of small computers in chemistry. Data acquisition typically involves an analog-to-digital converter subsystem to digitize voltage levels, the typical output of scientific apparatus. Although sometimes different analog levels are provided as output for control, control usually involves simply turning some device on or off or delivering a pulse.

In a series of articles in this Newsletter, I would like to indicate how data acquisition and control can be taught at moderate equipment costs using game ports. Alternatively, analog-to-digital converter subsystems and parallel port boards could be used but this would typically add $500 to the cost of each computer system. Such additional costs are justifiable when a particularly important interface problem demands it, but the principles of data acquisition and control can be adequately taught using the game port.

In this article, I will introduce the components of the game port. In the next issue, I want to gather together some of those applications that have been made. In a final article, I will introduce some experiments which introduce the fundamentals of data acquisition.

The Apple II Game Port

The Apple game port is accessed by a DIP connector on the main board of the computer. The socket is an ordinary integrated circuit socket, so you need a cable which is terminated with a DIP connector, available from Radio Shack and many hobbiest mail order concerns. The pins of this socket are defined as follows:

1	+5 volts	7	Potentiometer 2	12	Annunciator 3
2	Push button 0	8	GROUND	13	Annunciator 2
3	Push button 1	9	----	14	Annunciator 1
4	Push button 2	10	Potentiometer 1	15	Annunciator 0
5	STROBE*	11	Potentiometer 3	16	----
6	Potentiometer 0				

The +5 volt pin can supply up to 100 ma to your external device to light lamps or LEDs, etc.

The two pushbutton inputs are simple standard TTL inputs which are used in two typical ways. First, they were designed to detect a switch closure; if an ordinary mechanical switch is connected between the input and ground, the input will read a logical 0 when the switch is closed (the input is shorted to ground) and a logical 1 when the switch is open. If the device under study has a TTL-compatible output, connection of it directly to this input is possible.

The status of a pushbutton input is determined by programming. (In BASIC a function PEEK (49249) or PEEK (49250) provides information on the status of push button 0 and 1, respectively.

The four annunciator outputs are TTL outputs which can be used to deliver pulses or logical conditions to other TTL circuits, for example, to start various operations. Also, they can be used to control mechanical or solid-state relays, turn on power transistors, and in general turn almost anything on and off (except maybe back-row freshmen).

The annunciator outputs are turned on and off by writing statements which will access their addresses; the access may be either to READ (PEEK) from the port or to WRITE (POKE) to a port. For Annunciator 0, the statement I = PEEK(42940) will turn the output off; the statement I = PEEK(42941) will turn it back ON. For Annunciators 1-3, the corresponding address pairs are 49242/49243, 49244/49245, and 49246/49247.

The potentiometer input is a very special type of analog-to-digital converter input. Its operation is controlled by the computer, and we will not go into the method of conversion here since one method of using it is to use the PDL command in BASIC.

The result of a conversion is directly proportional to the resistance between the input and 5 volts. The maximum result (255) is delivered when that resistance is greater than or equal to 150 K Ω and the result will be zero when the resistance is zero. Therefore, the paddle input can be used as an ADC when the transducer (sensor) makes a large change in resistance.

The most obvious sensor is the paddle or a similar potentiometer. A single or multi-turn pot can be used to sense angle or, with a pulley, linear position. Since linear position can be related to a lot of things (force, speed, flow-rate, pressure, weight, etc.) with mechanical converters, this input could be quite versatile.

There are also several solid-state transducors which make a great change in resistance with change in a physical phenomenon. These phenomena include temperature, light-level and pulse-width.

Part II, the Next Installment.

Before the next issue, I need to hear from persons who have developed an application or an idea for an application using the game port. Of course, Apple IIs are not the only computers with game ports; many of the same capabilities are in Commodore 64's, VIC's, Atari's, etc.

I will construct a "bits and pieces" section on the topic using the following information:

Type of data acquired or device controlled;
Hardware (including source where that is important);
Circuit diagram where it is not obvious.

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Notes and Comments—A Bit of Serendipity
by Paul Cauchon*

Not long ago, I acquired an SX-64, the portable version of the popular Commodore-64. The obvious advantages of size and convenience were what led me to make the purchase, however, I was a bit apprehensive about working with the 5" schreen, since I am already wearing tri-focal glasses (bi-focals with a narrow window of visibility designed to focus at normal computer-screen distances). Two years after turning in my bi-focals, I still have not fully adjusted to the "computer lens", and continue to engage in awkward optical and cranial gymnastics during keyborad sessions, particularly when trying to distinguish eights from zeroes, or tracking a listing as it scrolls past. Well imagine my surprise when, after about an hour of testing (playing with my new machine) I suddenly realized that the screen was actually easier to read than either the full size PET or Apple monitors. Now, after several hours of serious coding, I am convinced that the small screen does not pose the kinds of visual problems I had envisioned. In fact, its just the opposite!

Quite simply, the reduced screen size enables me to view all 25 lines of text through my narrow 'seeing-slit' at a comfortable distance and from a relaxed position. I'm not sure it will work that way for all my fellow tri-focalists, but if you've been holding off buying convenience for fear of ruining your eyes even further, you might want to reconsider.

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