A versatile microcomputer I/O interface

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Interfacing microcomputers to control experiments requires the use of various types of programmable integrated-circuit chips. A versatile interface which permits control between the interface chips and various experimental devices is described.

Each new development in computer hardware has required a concomitant change in its peripheral interface system—that is, the hardware necessary for sensing input events from and controlling output events to the experimental environment (I/O). Several interfaces are described for specific minicomputers (Grisham & Frei, 1977; Silverman & Howard, 1976). These, unfortunately, are not suitable for the microcomputer I/O interface integrated-circuit (IC) chips, such as Motorola's peripheral interface adapter (PIA) 6820, MOS Technology's peripheral adapter 6520, or INTEL's programmable peripheral interface 8255A. This type of IC chip is used to interface the majority of microprocessors to their external I/O. The I/O lines are bidirectional, being programmable from the microprocessor. The chips are used as interfaces in machines ranging from the simplest microprocessor evaluation kits to complete microcomputers, such as the Commodore PET, South West Technical Corporations's 6800 computer, Radio Shack's TRS 80, Digital Equipment Corporations's LSI 11, Apple, Kimi, or Zilog Z-80.

After purchasing our first microcomputer (Commodore's PET), we designed a versatile I/O interface that mates with this type of interface chip. The advantages are low cost (\$80) and bus independence. For example, an interface described for the Imsai (Crossman & Williams, 1978) requires connection to its S-100 bus. The cost, \$2,600, is high for an experimenter on a low expense budget.

INTERFACE DESCRIPTION

The Versatile Interface is connected between the electromechanical devices (relays) at the experiment and the PET's parallel and IEEE connectors. Both the parallel and IEEE interfaces are programmable IC I/O chips using PEEK and POKE instructions. McLean (1978) described BASIC language software for data acquisition and experimental control using the PET.

The interface I/O consists of 8 lines of input data to the PET and 16 output control lines to the experiment. The PET's I/O consists of 16 bidirectional lines, or 8 each in the parallel and IEEE interfaces. The electrical connections from the interface to the PET and experiment are made with printed-circuit and snap connectors, respectively.

Experimental I/O lines, then, consist of any combination of the Versatile Interfaces's 8 input data lines and 16 output control lines as long as the following rules are followed: (1) The total number of input/output lines selected cannot exceed the maximum number of bidirectional control lines available at the PET (16 total)

Figure 1. An electrical schematic of the Versatile Interface output.

Figure 2. An electrical schematic of the Versatile Interface input.

and, (2) the total number of input data lines cannot exceed the maximum available on the Versatile Interface (8 total).

Selection of the input and output lines in the Versatile Interface is accomplished with a patchboard similar to a telephone patchboard, except that miniature PIN jacks and plugs are used on top of the enclosure.

The choice of 8 maximum input data lines and 16 maximum output controls at the interface was determined by the following: (1) More than 24 total lines required an enclosure larger than we desired; (2) a greater number of output controls than input data were desired. Multiplexing schemes or use of the IEEE interface as an IEEE interface increases both the number of I/O lines and the cost.

Data rates are dependent upon the number of experiments, number of inputs chosen, and their frequency of occurrence. Since eight inputs can be read in parallel, I/O input time is 200 msec.

The worst case would be eight inputs. Since eight inputs can be read in parallel, simultaneous events are not a problem unless they occur as a previous "read" is being stored. The amount of real-time analysis of data and consequential control required determine how much data can be lost. The interface can be checked every millisecond if required.

The Versatile Interface handles I/O signals for various voltage levels to and from the experiment. The maxi-

mum ratings for the signal drivers to the experiment are 40 V at 800 mA, which is sufficient to operate most relays found in present laboratories. Figures 1 and 2 provide schematics of the interface. Debouncing resistor-capacitor combinations are used for the signals from the experiment. Red and green light-emitting diodes (LEDs) indicate status information. Both inputs and outputs on the microcomputer side are opto-isolated to protect the microcomputer circuitry.

The Versatile Interface circuit board is wire-wrapped, with off-board connections made with IC plug connectors.

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