

Interfacing Microcomputers to Science Experiments

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Introduction

Microcomputers are available to most high school and college science teachers. Microcomputers would be used more often if the teachers knew how to interface them to experiments. The purpose of this project was to investigate the available literature and prepare a resource list for teachers to help them learn how to interface. This project was funded by the Indiana Academy of Science under the Fellowship Program for Secondary School Science Teachers.

Why Interface?

Why should a teacher learn how to interface a microcomputer?

1. A computer can take some data better than a human. Data may be taken automatically, periodically, every millisecond or every hour for 24 hours a day for a year or more. Human errors caused by boredom will be eliminated. The human is freed to pursue other more educational inquiries while the data is being collected.
2. A versatile interface can perform numerous functions and save money by eliminating the need for specialized pieces of equipment which can only perform one function.
3. The educator can program the computer to pre-lab the student, collect data, manipulate the data, store it, print the data, graph the data, or interact with the student to get more learning mileage from the experiment.
4. The computer can be used to control instruments. It can turn devices on or off. It can sound alarms when damaging temperature, water levels, pressures or even color changes occur.
5. Students can use the computer to do scientific investigations. One of our students investigated the effect of the color of the stimulus on reaction time. The computer randomly sounded a stimulus and measured the reaction time. The data was stored for a specified number of trials, which were alterable, and then would print out the data, graph the data, or statistically analyze the data.
6. Students will be introduced to high tech science. Scientists now use computers to collect data, control experiments and number crunch. Students can do the same thing.

How to Interface

The user has 4 approaches to interfacing. Graef (1) lists

1. add an A/D converter on a printed circuit board
2. add an external A/D converter using the computer's serial port
3. attach transducers to the game paddle ports or
4. connect an instrument to the computer.

In this investigation, the 3rd option was used because it has the lowest cost and is the least complicated. Most educators will use interfacing if they see the benefits and realize the cost will be minimal and the difficulty is low. Packaged interfacing equipment is convenient but is still too expensive for most high school teachers.

Rather than trying to tell someone how to interface, please refer to the resources listed by type of computer at the end of this article. If you can not find the resource articles, copies are available, when not copyrighted, from the authors.

Procedure

Library research was performed at Tri-State University, Ball State, Taylor, IPFW, Goshen, Notre Dame and North Manchester. Databases were searched by Tri-Also including ERIC, RICE, BRS.

The articles were photocopied and read. They were organized by computer type: Apple, TRS-80, Timex/Sinclair, Commodore and others. The articles were arranged from most useful to least useful, in the author's opinion.

Interfacing was performed with the Timex/Sinclair and Apple II Microcomputer by Replogle and the Commodore 64 by Pinkham. The Radio Shack was also available but it seems more difficult to interface than the other computers.

A VOTEM was purchased for the Timex at a cost of \$60 from Alger Salt, Box 3096, Greenville, NC 27834. It was already assembled and tested. Software suggestions, directions for connection to the Timex, and a temperature probe accompanied the A/D converter. Salt claims that the interface should be able to be connected to the Apple II but he was not able to tell the author how to do this.

A "blue box" was purchased for the Apple II from Sci-Comp, 2404 Cherokee St., Adelphi, MD 20783. The interface allows the user to use the game port on the Apple. For \$95 the interface, a light probe, thermometer probe, and solid state switch (to turn devices on/off automatically) was purchased. All components were already assembled and tested.

The author had previously attended an AAPT interfacing workshop at a NSTA convention in Boston, MA and had the software and instruction manual provided by that workshop. The "blue box" was used in that workshop. The workshop is highly recommended to any teacher interested in learning in one day how to interface.

What was Accomplished

With the Apple II, for under \$100, measurements were made of temperature, resistance, velocity, acceleration, light intensity, time, distance and heartbeat. Devices can be controlled with the Apple using the solid state switch.

With the Timex, for under \$70, measurements were made of temperature, frequency, voltage, resistance, current, absorbance, % transmittance, light intensity, distance, pH and strain. It is believed that pressure or mass could be measured using a transducer from Omega Engineering, Box 4047, Stamford, CT 06907. Excellent interfacing handbooks are available free from this address.

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Appendix

A. Apple Computer Interfacing Articles arranged from most useful to least useful to high school science teachers

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